SNI

SNI 04-3892.1-2006

Standar Nasional Indonesia

Tusuk-kontak dan kotak-kontak untuk keperluan rumah tangga dan sejenisnya – Bagian 1: Persyaratan umum

ICS 29.120.30

Badan Standardisasi Nasional

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Diterbitkan di Jakarta

Prakata

Standar Nasional Indonesia (SNI) mengenai "Tusuk-kontak dan kotak-kontak untuk keperluan rumah tangga dan sejenisnya - Bagian 1 : Persyaratan umum", diadopsi secara identik dari standar *International Electrotechnical Commission* (IEC) 60884-1 (2002-06) dengan judul *"Plugs and socket-outlets for household and similar purposes - Part 1: General requirements*".

SNI ini merupakan revisi dari SNI 04-3892.1-2001, Tusuk-kontak dan kotak-kontak untuk keperluan rumah tangga dan sejenisnya - Bagian 1 : Persyaratan umum

SNI ini digunakan bersamaan dengan SNI 04-3892.1.1-2003 mengenai Tusuk-kontak dan kotak-kontak untuk keperluan rumah-tangga dan sejenisnya. Bagian 1-1: Persyaratan umum - Bentuk dan ukuran

SNI ini dibuat masih dalam metode republikasi *(republication)* sesuai dengan acuan dan ketentuan yang berlaku dan akan dijadikan dalam Bahasa Indonesia dalam jangka waktu tertentu sesuai ketentuan yang berlaku dari Badan Standardisasi Nasional (BSN).

SNI ini dirumuskan oleh Panitia Teknis Peranti/Pemanfaat Listrik (PTPM) melalui proses/prosedur perumusan standar dan terakhir dibahas dalam Forum Konsensus XXIV pada tanggal 6-7 Desember 2005 di Jakarta.

Dalam rangka mempertahankan mutu ketersediaan SNI yang tetap mengikuti perkembangan, maka diharapkan masyarakat standardisasi ketenagalistrikan memberikan saran dan usul untuk revisi SNI ini dikemudian hari.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PLUGS AND SOCKET-OUTLETS FOR HOUSEHOLD AND SIMILAR PURPOSES –

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FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60884-1 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories.

This third edition cancels and replaces the second edition published in 1994, amendment 1 (1994) and amendment 2 (1995), and constitutes a technical revision.

The text of this standard is based on the second edition, the amendments 1 and 2 and the following documents:

FDIS	Report on voting
23B/658/FDIS	23B/664/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A and B form an integral part of this standard.

IEC 60884-1 consists of the following parts, under the general title *Plugs, and socket-outlets for household and similar purposes*:

– Part 1: General requirements

– Part 2-1: Particular requirements for fused plugs,

– Part 2-2: Particular requirements for socket-outlets for appliances

– Part 2-3: Particular requirements for switched socket-outlets without interlock for fixed installations

– Part 2-4: Particular requirements for plugs and socket-outlets for SELV

– Part 2-5: Particular requirements for adaptors

– Part 2-6: Particular requirements for switched socket-outlets with interlock for fixed installations

NOTE In this standard, the following print types are used.

– Requirements proper: in roman type;

– *Test specification: in italic type;*

– Explanatory matter: in smaller roman type.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

PLUGS AND SOCKET-OUTLETS FOR HOUSEHOLD AND SIMILAR PURPOSES –

Part 1: General requirements

1 Scope

This part of IEC 60884 applies to plugs and fixed or portable socket-outlets for a.c. only, with or without earthing contact, with a rated voltage greater than 50 V but not exceeding 440 V and a rated current not exceeding 32 A, intended for household and similar purposes, either indoors or outdoors.

The rated current is limited to 16 A maximum for fixed socket-outlets provided with screwless terminals.

This standard does not cover requirements for flush mounting boxes: however, it covers only those requirements for surface-type mounting boxes which are necessary for the tests on the socket-outlet.

NOTE 1 General requirements for mounting boxes are given in IEC 60670.

This standard also applies to plugs incorporated in cord sets, to plugs and portable socket-outlets incorporated in cord extension sets and to plugs and socket-outlets which are a component of an appliance, unless otherwise stated in the standard for the relevant appliance.

This standard does not apply to

– plugs, socket-outlets and couplers for industrial purposes;

– appliance couplers;

– plugs, fixed and portable socket-outlets for ELV;

NOTE 2 ELV values are specified in IEC 60364-4-41.

– fixed socket-outlets combined with fuses, automatic switches, etc.

NOTE 3 Socket-outlets with pilot lights are allowed provided that pilot lights comply with the relevant standard, if any.

Plugs and fixed or portable socket-outlets complying with this standard are suitable for use at ambient temperatures not normally exceeding 25 °C, but occasionally reaching 35 °C.

NOTE 4 Socket-outlets complying with this standard are only suitable for incorporation in equipment in such a way and in such a place that it is unlikely that the surrounding temperature exceeds 35 °C.

In locations where special conditions prevail, such as in ships, vehicles and the like and in hazardous locations, for example where explosions are liable to occur, special constructions may be required.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-442:1998, *International Electrotechnical Vocabulary – Part 442: Electrical accessories*

IEC 60050-826:1982, *International Electrotechnical Vocabulary – Part 826: Electrical installations of buildings*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*

IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall (Procedure 1)*

IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60417-2:1998, *Graphical symbols for use on equipment – Part 2: Symbol originals*

IEC 60423:1993, *Conduits for electrical purposes – Outside diameters of conduits for electrical installations and threads for conduits and fittings*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60884-2-6:1997, *Plugs and socket-outlets for household and similar purposes – Part 2-6: Particular requirements for switched socket-outlets with interlock for fixed electrical installations*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*

ISO 1456:1988, *Metallic coatings – Electrodeposited coatings of nickel plus chromium and of copper plus nickel plus chromium*

ISO 1639:1974, *Wrought copper alloys – Extruded sections – Mechanical properties* [1)]

ISO 2039-2:1987, *Plastics – Determination of hardness – Part 2: Rockwell hardness*

ISO 2081:1986, *Metallic coatings – Electroplated coatings of zinc on iron or steel*

ISO 2093:1986, *Electroplated coatings of tin – Specification and test methods*

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1) Withdrawn

3 Definitions

For the purposes of this part of IEC 60884, the definitions given in IEC 60050(151) as well as the following definitions apply.

NOTE 1 Where the terms "voltage" and "current" are used, they imply r.m.s. values, unless otherwise specified.

NOTE 2 Throughout this standard the word "earthing" is used for “protective earthing”.

NOTE 3 The term "accessory" is used as a general term covering plugs and socket-outlets; the term "portable accessory" covers plugs and portable socket-outlets. Examples of the use of accessories are shown in figure 1a.

NOTE 4 Throughout this standard the term "socket-outlet" covers both fixed and portable socket-outlets, except where the reference is specific to one type or the other.

3.1
plug
accessory having pins designed to engage with the contacts of a socket-outlet, also incorporating means for the electrical connection and mechanical retention of flexible cable

3.2
socket-outlet
accessory having socket-contacts designed to engage with the pins of a plug and having terminals for the connection of cable

3.3
fixed socket-outlet
socket-outlet intended to be connected to fixed wiring

3.4
portable socket-outlet
socket-outlet intended to be connected to, or integral with, the flexible cable and which can easily be moved from one place to another while connected to the supply

3.5
multiple socket-outlet
combination of two or more socket-outlets

NOTE An example is shown in figure 1b.

3.6
socket-outlet for appliances
socket-outlet intended to be built in, or fixed to, appliances

3.7
rewirable plug or rewirable portable socket-outlet
accessory so constructed that the flexible cable can be replaced

3.8
non-rewirable plug or non-rewirable portable socket-outlet
accessory so constructed that it forms a complete unit with the flexible cable after connection and assembly by the manufacturer of the accessory (see also 14.1)

3.9
moulded-on accessory
non-rewirable portable accessory, the manufacture of which is completed by insulating material moulded around pre-assembled component parts and the terminations for the flexible cable

[IEV 442-01-14, modified]

3.10
mounting box
box intended for mounting in or on a wall, floor or ceiling, etc., for flush or surface application, intended for use with fixed socket-outlet(s)

3.11
cord set
assembly consisting of a flexible cable fitted with a plug and a connector, intended for the connection of an electrical appliance to the electrical supply

3.12
cord extension set
assembly consisting of a flexible cable fitted with a plug and a portable socket-outlet

3.13
terminal
insulated or non-insulated connecting device intended for reusable electrical connection of the external conductors

3.14
termination
insulated or non-insulated connecting device intended for non-reusable electrical connection of the external conductors

3.15
clamping unit
part or parts of a terminal necessary for the mechanical clamping and the electrical connection of the conductor(s)

3.16
screw-type terminal
terminal for the connection and subsequent disconnection of a conductor or the interconnection of two or more conductors, capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

3.17
pillar terminal
screw-type terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the end of the screw or screws. The clamping pressure may be applied directly by the end of the screw or through an intermediate clamping member to which pressure is applied by the end of the screw

NOTE Examples of pillar terminals are shown in figure 2.

3.18
screw terminal
screw-type terminal in which the conductor is clamped under the head of the screw.

The clamping pressure may be applied directly to the head of a screw or through an intermediate part, such as a washer, clamping plate or anti-spread device

NOTE Examples of screw terminals are shown in figure 3.

3.19
stud terminal
screw-type terminal in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device

NOTE Examples of stud terminals are shown in figure 3.

3.20
saddle terminal
screw-type terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts

NOTE Examples of saddle terminals are shown in figure 4.

3.21
mantle terminal
screw-type terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot

NOTE Examples of mantle terminals are shown in figure 5.

3.22
screwless terminal
connecting device for the connection and subsequent disconnection of a rigid (solid or stranded) or flexible conductor or the interconnection of two or more conductors, capable of being dismantled, the connection being made, directly or indirectly, by means of springs, parts of angled, eccentric or conical form, etc., without special preparation of the conductor concerned, other than removal of insulation

3.23
thread-forming screw
screw having an uninterrupted thread, which by screwing in, forms a thread by displacing material

NOTE An example of a thread-forming screw is shown in figure 6.

3.24
thread-cutting screw
screw having an interrupted thread, which by screwing in, forms a thread by removing material

NOTE An example of a thread-cutting screw is shown in figure 7.

3.25
rated voltage
voltage assigned to the plug or socket-outlet by the manufacturer, which will be that specified in the standard sheet, if any

3.26
rated current
current assigned to the plug or socket-outlet by the manufacturer, which will be that specified in the standard sheet, if any

3.27
shutter
movable part incorporated into a socket-outlet arranged to shield at least the live socket-outlet contacts automatically when the plug is withdrawn

3.28
type test
test of one or more devices made to a certain design to show that the design meets certain specifications

3.29
routine test
test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

3.30
base
part of the socket-outlet supporting the socket-contacts

3.31
live part
conductor or conductive part intended to be energized in normal use, including a neutral conductor, but, by convention, not a PEN conductor

[IEV 826-03-01]

4 General requirements

Accessories and surface-type mounting boxes shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or the surroundings within the meaning of this standard.

Compliance is checked by meeting all the relevant requirements and tests specified.

5 General notes on tests

5.1 *Tests shall be made to prove compliance with the requirements laid down in this standard, where applicable.*

Tests are made as follows:

type tests shall be made on representative specimens of each accessory;

routine tests shall be made on each accessory manufactured according to this standard, where applicable.

Subclauses 5.2 to 5.5 are applicable to type tests and 5.6 to routine tests.

5.2 *Unless otherwise specified, the specimens are tested as delivered and under normal conditions of use.*

Non-rewirable accessories are tested with the type and size of flexible cable as delivered; those not incorporated in a cord set or a cord extension set, or which are not a component of equipment, shall be provided, for testing, with at least 1 m of flexible cable.

Non-rewirable multiple portable socket-outlets are tested with flexible cables as delivered.

Socket-outlets which do not comply with any accepted standard sheet are tested together with the corresponding boxes.

Socket-outlets which require a box to complete their enclosure are tested with their boxes.

5.3 *Unless otherwise specified, the tests are carried out in the order of the clauses, at an ambient temperature between 15 °C and 35 °C.*

In case of doubt, the tests are made at an ambient temperature of (20 ± 5) °C.

Plugs and socket-outlets are tested separately.

The neutral, if any, is treated as a pole.

5.4 *Three specimens are subjected to all the relevant tests.*

For the tests of 12.3.11, additional specimens of socket-outlets having in total at least five screwless terminals are required.

For the tests of 12.3.12, three additional specimens of socket-outlets are necessary; in each specimen one clamping unit is tested.

For each of the tests of 13.22 and 13.23, three additional specimens of separate membranes, or of accessories incorporating membranes, are required.

For non-rewirable accessories, six additional specimens are required for the test of 23.2 and 23.4.

For the test of 24.10, three additional specimens are required.

For the test of clause 28, three additional specimens may be necessary.

NOTE A table showing the number of specimens needed for the tests is given in annex B.

5.5 *The specimens are submitted to all the relevant tests and the requirements are satisfied if all the tests are met.*

If one specimen does not satisfy a test due to an assembly or a manufacturing fault, that test and any preceding one which may have influenced the results of the test shall be repeated, and also the tests which follow shall be made in the required sequence on another full set of specimens, all of which shall comply with the requirements.

NOTE The applicant may submit, together with a number of specimens specified in 5.4, the additional set of specimens which may be required, should one specimen fail. The testing station will then, without further request, test the additional specimens and will only reject them if a further failure occurs. If the additional set of specimens is not submitted at the same time, the failure of one specimen will entail rejection.

5.6 *Routine tests are specified in annex A.*

6 Ratings

6.1 Accessories should preferably be of a type and preferably have a voltage and current rating as shown in table 1.

Table 1 – Preferred combinations of types and ratings

Type	Rated voltage V	Rated current A
2P (non-rewirable plugs only)	130 or 250	2,5
2P (plugs only)	130 or 250	6
2P 2P + ⏚	130 or 250	10 16 32
2P + ⏚ 3P + ⏚ 3P + N + ⏚	440	16 32
NOTE Standardized values and configurations of existing systems are reported in IEC 60083.		

NOTE In the following countries fixed 2P socket-outlets are not allowed: AT, CH, DE, IT.

6.2 In a cord extension set, the rated current of the portable socket-outlet shall not be higher and the rated voltage shall not be less than that of the plug.

Compliance is checked by inspection of the marking.

6.3 Accessories should preferably have a degree of protection IP20, IP40, IP44, IP54 or IP55.

7 Classification

7.1 Accessories classification

7.1.1 Classification according to the degree of protection against access to hazardous parts and against harmful effects due to the ingress of solid foreign objects

– IP2X: accessories protected against access to hazardous parts with a finger and against harmful effects due to ingress of solid foreign objects of 12,5 mm diameter and greater
– IP4X: accessories protected against access to hazardous parts with a wire and against harmful effects due to ingress of solid foreign objects of 1,0 mm diameter and greater
– IP5X: accessories protected against access to hazardous parts with a wire and dust protected

7.1.2 Classification according to the degree of protection against harmful effects due to the ingress of water

– IPX0: accessories not protected against ingress of water
– IPX4: accessories protected against splashing water
– IPX5: accessories protected against water jets

NOTE For an explanation of IP codes see IEC 60529.

7.1.3 Classification according to the provision for earthing

– Accessories without earthing contact
– Accessories with earthing contact

7.1.4 Classification according to the method of connecting the cable

– Rewirable accessories
– Non-rewirable accessories

7.1.5 Classification according to the type of terminals

– Accessories with screw-type terminals
– Accessories with screwless terminals for rigid conductors only
– Accessories with screwless terminals for rigid and flexible conductors

7.2 Socket-outlets classification

7.2.1 Classification according to the degree of protection against electric shock

Socket-outlets are classified according to the degree of protection against electric shock when mounted as for normal use:

a) socket-outlets with normal protection (see 10.1), or
b) socket-outlets with increased protection (see 10.7).

NOTE Socket-outlets with increased protection may be socket-outlets with or without shutters.

7.2.2 Classification according to the existence of shutters

Socket-outlets are classified according to the existence of shutters, in

a) socket-outlets without shutters, or
b) socket-outlets with shutters (see 10.5).

NOTE In the following countries, socket-outlets without shutters are not allowed: IT.

7.2.3 Classification according to the method of application/mounting of the socket-outlet:

Socket-outlets are classified according to the method of application/mounting of the socket-outlet, in

a) surface type,
b) flush type,
c) semi flush type,
d) panel type,
e) architrave type,
f) portable type,
g) table type (single or multiple),
h) floor recessed type, or
i) appliance type socket-outlets.

7.2.4 Classification according to the method of installation

Socket-outlets are classified according to the method of installation, as a consequence of the design, in

a) fixed socket-outlets where the cover or cover-plate can be removed without displacement of the conductors (design A), or

b) fixed socket-outlets where the cover or cover-plate cannot be removed without displacement of the conductors (design B).

NOTE If a fixed socket-outlet has a base (main part) which cannot be separated from the cover or cover-plate, and requires a supplementary plate to meet the standard which can be removed for redecorating the wall without displacement of the conductors, it is considered to be of design A, provided the supplementary plate meets the requirements specified for covers and cover-plates.

7.2.5 Classification according to the intended use

Socket-outlets are classified according to intended use, in

a) socket-outlets for circuits where a single earthing circuit provides protective earthing for connected equipment and exposed conductive parts of the socket-outlet, if any;

b) socket-outlets for circuits where electrical noise immunity is desired for the earthing circuit of connected equipment. The equipment earthing circuit is electrically separated from the protective earthing circuit provided for the exposed conductive parts of the socket-outlet, if any.

7.3 Plugs classification

Plugs are classified according to the class of equipment to which they are intended to be connected in

– plugs for equipment of class 0,
– plugs for equipment of class I, or
– plugs for equipment of class II.

For the description of the classes of equipment, see IEC 61140.

NOTE Plugs for equipment of class 0 are permitted in the following countries: DK, FI, JP, NL, PT, SE.

8 Marking

8.1 Accessories shall be marked as follows:

– rated current in amperes;
– rated voltage in volts;
– symbol for nature of supply;
– manufacturer's or responsible vendor's name, trade mark or identification mark;
– type reference which may be a catalogue number;
– first characteristic numeral for the degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects, if declared to be higher than 2, in which case the second characteristic numeral shall also be marked;
– second characteristic numeral for the degree of protection against harmful effects due to ingress of water, if declared to be higher than 0, in which case the first characteristic numeral shall also be marked.

If the system allows plugs of a certain IP rating to be introduced into socket-outlets having another IP rating, attention should be drawn to the fact that the resulting degree of protection of the combination plug/socket-outlet is the lower of the two. They shall be stated in the manufacturer's literature related to the socket-outlet.

NOTE 1 The degrees of protection are based on IEC 60529.

In addition, socket-outlets with screwless terminals shall be marked with the following:

– an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal,
– an indication of the suitability to accept rigid conductors only, for those socket-outlets having this restriction.

NOTE 2 The additional markings may be put on the socket-outlet, on the packaging unit and/or given in an instruction sheet which accompanies the socket-outlet.

8.2 When symbols are used, they shall be as follows:

Amperes ..... A
Volts V
Alternating current ..... ~
Neutral ..... N

Protective earth ..... 
Degree of protection, when relevant ..... IPXX
Degree of protection for fixed accessories to be installed on rough surfaces
(test wall of figure 15) ..... IPXX

NOTE 1 Details of construction of symbols are given in IEC 60417-2.

NOTE 2 In the IP code the letter "X" is replaced by the relevant number.

NOTE 3 Lines formed by the construction of the tool are not considered as part of the marking.

For the marking with rated current and rated voltage the figures may be used alone. These figures shall be placed on one line separated by an oblique line or the figure for rated current shall be placed above the figure for rated voltage, separated by a horizontal line.

The marking for the nature of supply shall be placed next to the marking for rated current and rated voltage.

NOTE 4 The marking for current, voltage and nature of supply may be, for example, as follows:

$$16\ \text{A}\ 440\ \text{V}\sim \text{ or } 16/440\sim \text{ or } \frac{16}{440}$$

8.3 For fixed socket-outlets the following marking shall be placed on the main part:

– rated current, rated voltage and nature of supply;
– either the name, trade mark or identification mark of the manufacturer or of the responsible vendor;
– length of insulation to be removed before the insertion of the conductor into the screwless terminal, if any;
– the type reference, which may be a catalogue number.

NOTE 1 The type reference may be the series reference only.

Parts such as cover plates, which are necessary for safety purposes and are intended to be sold separately, shall be marked with the manufacturer's or responsible vendor's name, trade mark or identification mark and type reference.

NOTE 2 Additional type references may be marked on the main part, or on the outside of the associated enclosure.

NOTE 3 The term "main part" means the part carrying the socket contacts.

The IP code, if applicable, shall be marked so as to be easily discernible when the socket-outlet is mounted and wired as for normal use.

Fixed socket-outlets classified according to item b) of 7.2.5 shall be identified by a triangle which shall be visible after installation unless they have an interface configuration which is different from that used in normal circuits.

NOTE 4 In the following countries an orange triangle is required by the national installation rules: CA, US.

8.4 For plugs and portable socket-outlets the marking specified in 8.1, other than the type reference, shall be easily discernible when the accessory is wired and assembled.

Plugs and portable socket-outlets for equipment of class II shall not be marked with the symbol for class II construction.

NOTE The type reference of rewirable portable accessories may be marked on the inside of the enclosure or cover.

8.5 Terminals intended exclusively for the neutral conductor shall be indicated by the letter N.

Earthing terminals for the connection of the protective conductor shall be indicated by the symbol  .

These markings shall not be placed on screws, or any other easily removable parts.

NOTE 1 "Easily removable parts" are those parts which can be removed during the normal installation of the socket-outlet or the assembly of the plug.

NOTE 2 Terminations in non-rewirable accessories need not be marked.

Terminals provided for the connection of conductors not forming part of the main function of the socket-outlets shall be clearly identified unless their purpose is self-evident, or indicated in a wiring diagram which shall be fixed to the accessory.

The indication of such terminals may be achieved by

– their being marked with graphical symbols according to IEC 60417-2 or colours and/or alphanumeric system, or
– their being marked with their physical dimensions or relative location.

Leads of neon or indicator lamps are not considered to be conductors in the context of this subclause.

8.6 For surface-type mounting boxes forming an integral part of socket-outlets having an IP code higher than IP20, the IP code shall be marked on the outside of its associated enclosure so as to be easily discernible when the socket-outlet is mounted and wired as in normal use.

8.7 It shall be indicated either by marking or in a manufacturer's catalogue or instruction sheet in which position or with which special provisions (for example, box, type of mounting surface, plug, etc.) the declared degree of protection of flush-type and semi-flush-type fixed socket-outlets having an IP code higher than IPX0 is ensured.

Compliance is checked by inspection.

8.8 Marking shall be durable and easily legible.

Compliance is checked by inspection and by the following test.

The marking is rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

NOTE 1 Marking made by impression, moulding, pressing or engraving is not subjected to this test.

NOTE 2 It is recommended that the petroleum spirit used consists of a solvent hexane with an aromatic content of maximum 0,1 volume percentage, a kauributanol value of approximately 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a density of approximately 0,68 g/cm^3.

9 Checking of dimensions

9.1 Accessories and surface-type mounting boxes shall comply with the appropriate standard sheets, if any.

Insertion of plugs into fixed or portable socket-outlets shall be ensured by their compliance with the relevant standard sheets.

Compliance is checked as follows.

Socket-outlets are first subjected to 10 insertions and 10 withdrawals of a plug complying with the corresponding standard sheet having the maximum dimensions for the pins following which dimensions are checked by measurement and/or by means of gauges.

The manufacturing tolerances of these gauges shall be as shown in table 2 if not otherwise specified. The most unfavourable dimensions of the standard sheet shall be used for the design of the gauges.

NOTE In some cases (for example, distances between centres), it may be necessary to check both the extreme dimensions.

Table 2 – Gauge tolerances

Gauge for checking	Gauge tolerance mm
Pin diameter or pin thickness	$^{0}_{0,01}$
Dimension of entry holes corresponding to pin diameter and to distance between contact surfaces	$^{+0,01}_{0}$
Pin length and width	$^{0}_{0,1}$
Pin spacing	$^{0}_{0,02}$ or $^{+0,02}_{0}$ (according to the case)
Distance from the engagement face to point of first electrical contact (for socket-outlet)	$^{0}_{0,05}$ or $^{+0,05}_{0}$ (according to the case)
Guiding elements	±0,03

9.2 It shall not be possible, within a given system, to engage a plug with

– a socket-outlet having a higher voltage rating or a lower current rating;

– a socket-outlet with a different number of live poles; exceptions may be admitted for socket-outlets which are specially constructed for the purpose of allowing engagement with plugs of a lower number of poles, provided that no dangerous situation can arise, for example a connection between a live pole and an earthing contact or the interruption of the earthing circuit;

– a socket-outlet with earthing contact, if the plug is a plug for class 0 equipment.

It shall not be possible to engage a plug for equipment of class 0 or of class I with a socket-outlet exclusively designed to accept plugs for class II equipment.

Compliance is checked by inspection or by manual test using gauges, the manufacturing tolerances of which shall be as specified in table 2.

In case of doubt, the impossibility of insertion is checked by applying the appropriate gauge for 1 min with a force of 150 N for accessories with a rated current not exceeding 16 A, or 250 N for other accessories.

Where the use of elastomeric or thermoplastic material is likely to influence the result of the test, it is carried out at an ambient temperature of (35 ± 2) °C, both the accessories and the gauges being at this temperature.

NOTE For accessories of rigid material, such as thermosetting resins, ceramic material and the like, conformity to the relevant standard sheets ensures compliance with the requirement.

9.3 Deviations from the dimensions specified in the standard sheets may be made, but only if they provide a technical advantage and do not adversely affect the purpose and safety of accessories complying with the standard sheet, especially with regard to interchangeability and non-interchangeability.

Accessories with such deviations shall, however, comply with all other requirements of this standard as far as they reasonably apply.

10 Protection against electric shock

NOTE For the purposes of this clause, lacquer, enamel and sprayed insulating coatings are not considered as insulating material.

10.1 Socket-outlets shall be so designed and constructed that when they are mounted and wired as for normal use, live parts are not accessible, even after removal of parts which can be removed without the use of a tool.

Live parts of plugs shall not be accessible when the plug is in partial or complete engagement with a socket-outlet.

NOTE In the following countries this requirement does not apply when the plug is partially engaged: CH, CA, DK, JP, US.

Compliance is checked by inspection and, if necessary, by the following test.

The test is made on the specimen mounted as for normal use and fitted with conductors of the smallest nominal cross-sectional area, the test being then repeated using conductors of the largest nominal cross-sectional area, specified in table 3.

The standard test finger, test probe B of IEC 61032, is applied in every possible position, an electrical indicator with a voltage between 40 V and 50 V being used to show contact with the relevant parts.

For plugs, the test finger is applied when the plug is in partial and complete engagement with a socket-outlet.

For accessories where the use of thermoplastic or elastomeric material is likely to influence the requirements, one additional test is made but at an ambient temperature of (35 ± 2)°C, the accessories being at this temperature.

During this additional test the accessories are subjected for 1 min to a force of 75 N, applied through the tip of a straight unjointed test finger, test probe 11 of IEC 61032. This finger with an electrical indicator as described above is applied to all places where yielding of insulating material could impair the safety of the accessory, but is not applied to membranes or the like and is applied to thin-walled knock-outs but with a force of 10 N.

During this test, accessories, with their associated mounting means, shall not deform to such an extent that those dimensions shown in the relevant standard sheets which ensure safety are unduly altered and no live parts shall be accessible.

Each specimen of plug or portable socket-outlet is then pressed between two flat surfaces with a force of 150 N for 5 min, as shown in figure 8. The specimen is checked 15 min after removal from the test apparatus, and shall not show such deformation as it would result in undue alteration of those dimensions shown in the relevant standard sheets which ensure safety.

10.2 Parts which are accessible when the accessory is wired and mounted as for normal use, with the exception of small screws and the like, isolated from live parts, for fixing bases and covers or cover-plates of socket-outlets, shall be made of insulating material; however, the covers or cover-plates of fixed socket-outlets and accessible parts of plugs and portable socket-outlets may be made of metal if the requirements given in 10.2.1 or 10.2.2 are fulfilled.

10.2.1 Metal covers or cover-plates are protected by supplementary insulation made by insulating linings or insulating barriers fixed to covers or cover-plates or to the body of accessories, in such a way that the insulating linings or insulating barriers cannot be removed without being permanently damaged, or so designed that they cannot be replaced in an incorrect position and that, if they are omitted, the accessories are rendered inoperable or manifestly incomplete and there is no risk of accidental contact between live parts and metal covers or cover-plates, for example through their fixing screws, even if a conductor should come away from its terminal, and if precautions are taken in order to prevent creepage distances or clearances becoming less than the values specified in table 23.

In the case of single-pole insertion, the requirement given in 10.3 applies.

Compliance is checked by inspection.

The above linings or barriers shall comply with the tests of clauses 17 and 27.

10.2.2 Metal covers or cover-plates are automatically connected, through a low resistance connection, to the earth during fixing of the cover or the cover-plate itself.

The creepage distances and the clearances between the live pins of a plug when fully inserted and the earthed metal cover of a socket-outlet shall comply with items 2 and 7 of table 23, respectively; in addition, in the case of single-pole insertion, the requirement given in 10.3 applies.

NOTE 1 Fixing screws or other means are allowed.

NOTE 2 In the following countries this alternative is not allowed: FI, DK (only IPX0 equipment), NO, FI, SE (only portable accessories).

Compliance is checked by inspection and by the tests of 11.5.

10.3 It shall not be possible to make contact between a pin of a plug and a live socket-contact of a socket-outlet while any other pin is accessible.

Compliance is checked by manual test and by means of gauges based on the most unfavourable dimensions of the standard sheet, the tolerances of the gauges shall be as specified in table 2.

For accessories with enclosures or bodies of thermoplastic material, the test is made at an ambient temperature of (35 ± 2) °C, both the accessory and the gauge being at this temperature.

For socket-outlets with enclosures or bodies of rubber or polyvinyl chloride, the gauge is applied with a force of 75 N for 1 min.

For fixed socket-outlets provided with metal covers or cover-plates, a clearance, between a pin and a socket-contact, of at least 2 mm is required, when another pin is or other pins are in contact with the metal covers or cover-plates.

NOTE 1 Single-pole insertion may be prevented by the use of at least one of the following means:

– a sufficiently large cover or cover-plate;

– other means (for example, shutters).

NOTE 2 In the following countries the use of a shutter as the only means to prevent single-pole insertion is not allowed: AT, BE, CA, CZ, DE, ES, FI, NL, PT, UK, US.

10.4 External parts of plugs, with the exception of assembly screws and the like, current-carrying and earthing pins, earthing straps and metal rings around pins and accessible metal parts fulfilling the requirements of 10.2, shall be of insulating material.

The overall dimensions of rings, if any, around pins shall not exceed 8 mm concentric with respect to the pin.

Compliance is checked by inspection.

10.5 Shuttered socket-outlets shall, in addition, be so constructed that live parts are not accessible without a plug in engagement, with the gauges shown in figures 9 and 10.

The gauges shall be applied to the entry holes corresponding to the live contacts only and shall not touch live parts.

To ensure this degree of protection, socket-outlets shall be so constructed that live contacts are automatically screened when the plug is withdrawn.

The means for achieving this shall be such that they cannot easily be operated by anything other than a plug and shall not depend upon parts which are liable to be lost.

An electrical indicator with a voltage between 40 V and 50 V included is used to show contact with the relevant part.

Compliance is checked by inspection and for socket-outlets with a plug completely withdrawn by applying the above gauges as follows.

The gauge according to figure 9 is applied to the entry holes corresponding to the live contacts with a force of 20 N.

The gauge is applied to the shutters in the most unfavourable position, successively in three directions, to the same place for approximately 5 s in each of the three directions.

During each application the gauge shall not be rotated and it shall be applied in such a way that the 20 N force is maintained. When moving the gauge from one direction to the next, no force is applied but the gauge shall not be withdrawn.

A steel gauge, according to figure 10, is then applied with a force of 1 N and in three directions, for approximately 5 s in each direction, with independent movements, withdrawing the gauge after each movement.

For socket-outlets with enclosures or bodies of thermoplastic material, the test is made at an ambient temperature of (35 ± 2)°C, both the socket-outlets and the gauge being at this temperature.

10.6 Earthing contacts, if any, of a socket-outlet shall be so designed that they cannot be deformed by the insertion of a plug, to such an extent that safety is impaired.

Compliance is checked by the following test.

The socket-outlet is placed in such a position that the socket-contacts are in a vertical position.

A test plug, corresponding to the type of socket-outlet, is inserted into the socket-outlet with a force of 150 N which is applied for 1 min.

After this test, the socket-outlet shall still comply with the requirements of clause 9.

10.7 Socket-outlets with increased protection shall be so constructed that, when mounted and wired as in normal use, live parts shall not be accessible.

Compliance is checked by inspection and by applying with a test wire of 1,0 mm diameter (see figure 10) a force of 1 N on all accessible surfaces in the most unfavourable conditions without a plug inserted.

For socket-outlets with enclosures or bodies of thermoplastic material, the test is made at an ambient temperature of (35 ± 2) °C, both the socket-outlets and the gauge being at this temperature.

During this test, it shall not be possible to touch live parts with the gauge.

An electrical indicator as described in 10.1 shall be used.

11 Provision for earthing

11.1 Accessories with earthing contacts shall be so constructed that when inserting the plug the earth connection is made before the current-carrying contacts of the plug become live.

When withdrawing the plug, the current-carrying pins shall separate before the earth connection is broken.

Compliance is checked by inspection of the manufacturing drawings, taking into account the effect of tolerances, and by checking the specimens against these drawings.

NOTE Conformity with the relevant standard sheets ensures compliance with this requirement.

11.2 Earthing terminals of rewirable accessories shall comply with the appropriate requirements of clause 12.

They shall be of the same size as the corresponding terminals for the supply conductors.

Earthing terminals of rewirable accessories with earthing contact shall be internal.

Fixed socket-outlets can have an additional external earthing terminal. This earthing terminal shall be of a size suitable for conductors of at least 6 mm^2.

Earthing terminals of fixed socket-outlets shall be fixed to the base or to a part reliably fixed to the base.

Earthing contacts of fixed socket-outlets shall be fixed to the base or to the cover, but, if fixed to the cover, they shall be automatically and reliably connected to the earthing terminal when the cover is put in place, the contact pieces being silver-plated or having a protection no less resistant to corrosion and abrasion.

This connection shall be ensured under all conditions which may occur in normal use, including loosening of cover-fixing screws, careless mounting of the cover, etc.

Except as mentioned above, parts of the earthing circuit shall be in one piece or shall be reliably connected together by riveting, welding, or the like.

NOTE 1 The requirement regarding the connection between an earthing contact fixed to a cover and an earthing terminal may be met by the use of a solid pin and a resilient socket-contact.

NOTE 2 For the purpose of the requirements of this subclause, screws are not considered as parts of contact pieces.

NOTE 3 When considering the reliability of the connection between parts of the earthing circuit, the effect of possible corrosion is taken into account.

11.3 Accessible metal parts of fixed socket-outlets with earthing contact, which may become live in the event of an insulation fault, shall be permanently and reliably connected to the earthing terminal.

NOTE 1 This requirement does not apply to the metal cover-plates mentioned in 10.2.1.

NOTE 2 For the purpose of this requirement, small screws and the like, electrically separated from live parts, for fixing bases, covers, or cover-plates, are not considered as accessible parts which may become live in the event of an insulation fault.

NOTE 3 This requirement means that, for fixed socket-outlets with metal enclosures having an external earthing terminal, this terminal is interconnected with the terminal fixed to the base.

11.4 Socket-outlets, having an IP code higher than IPX0, with an enclosure of insulating material, having more than one cable inlet, shall be provided with an internal fixed earthing terminal or adequate space for a floating terminal allowing the connection of an incoming and an outgoing conductor for the continuity of the earthing circuit unless the earthing terminal of the socket-outlet itself is so designed that it allows the connection of an incoming and an outgoing earthing conductor.

Floating terminals are not subject to the requirements of clause 12.

Compliance with 11.2 to 11.4 is checked by inspection and by the tests of clause 12.

Compliance with requirements to ensure adequate space for floating terminals is checked by performing a test connection using the type of terminal specified by the manufacturer.

11.5 The connection between the earthing terminal and accessible metal parts to be connected thereto, shall be of low resistance.

Compliance is checked by the following test.

A current derived from an a.c. source having a no-load voltage not exceeding 12 V and equal to 1,5 times the rated current or 25 A, whichever is the greater, is passed between the earthing terminal and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal and the accessible metal part is measured, and the resistance calculated from the current and this voltage drop.

In no case shall the resistance exceed 0,05 .

NOTE Care should be taken that the contact resistance between the tip of the measuring probe and the metal part under test does not influence the test results.

11.6 Fixed socket-outlets according to item b) of 7.2.5, for use on circuits where electrical noise immunity is desired for connected equipment, shall have the earthing socket contact and its terminal electrically separated from any metal mounting means or other exposed conductive parts which may be connected to the protective earthing circuit of the installation.

Compliance is checked by inspection.

12 Terminals and terminations

12.1 General

All the tests on terminals, with the exception of the test of 12.3.11 and 12.3.12 shall be made after the tests of clause 16.

12.1.1 Rewirable fixed socket-outlets shall be provided with screw-type terminals or with screwless terminals.

Rewirable plugs and rewirable portable socket-outlets shall be provided with terminals with screw clamping.

If pre-soldered flexible conductors are used, care shall be taken that in screw-type terminals the pre-soldered area shall be outside the clamp area when connected as for normal use.

The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

12.1.2 Non-rewirable accessories shall be provided with soldered, welded, crimped or equally effective permanent connections (termination); screwed or snap-on connections shall not be used.

Connections made by crimping a pre-soldered flexible conductor are not permitted, unless the soldered area is outside the crimping area.

12.1.3 *Compliance is checked by inspection and by the tests of 12.2 or 12.3, as applicable.*

12.2 Terminals with screw clamping for external copper conductors

12.2.1 Accessories shall be provided with terminals which shall allow the proper connection of copper conductors having nominal cross-sectional areas as shown in table 3.

Table 3 – Relationship between rated current and connectable nominal cross-sectional areas of copper conductors

Current and type of accessory	Rigid (solid or stranded) copper conductors [c]		Flexible copper conductors	
	Nominal cross-sectional area mm²	Diameter of the largest conductor mm	Nominal cross-sectional area mm²	Diameter of the largest conductor mm
6 A	-	–	From 0,75 up to 1,5 inclusive	1,73
10 A 2P and 2P+ ⏚ (fixed accessory)	From 1 up to 2,5 inclusive [a]	2,13	–	–
10 A 2P and 2P+ ⏚ (portable accessory)	–	–	From 0,75 up to 1,5 inclusive	1,73
16 A 2P and 2P + ⏚ (fixed accessory)	From 1,5 up to 2 2,5 inclusive [b]	2,13	–	–
16 A 2P and 2P + ⏚ (portable accessory)	–	–	From 0,75 up to 1,5 inclusive	1,73
16 A other than 2P and 2P + ⏚ (fixed accessory)	From 1,5 up to 4 inclusive	2,72	–	–
16 A other than 2P and 2P + ⏚ (portable accessory)			From 1 up to 2,5 inclusive	2,21

Current and type of accessory	Rigid (solid or stranded) copper conductors [c]		Flexible copper conductors	
	Nominal cross-sectional area mm²	Diameter of the largest conductor mm	Nominal cross-sectional area mm²	Diameter of the largest conductor mm
32 A (fixed accessory)	From 2,5 up to 10 inclusive	4,32	–	–
32 A (portable accessory)			From 2,5 up to 6 inclusive	3,87

[a] The terminal shall allow the connection of two 1,5 mm² conductors which have a diameter of 1,45 mm.

[b] Some countries require the looping-in of three conductors of 2,5 mm², or two conductors of 4 mm².

[c] The use of flexible conductors is permitted.

The conductor space shall be at least that specified in figures 2, 3, 4 or 5.

Compliance is checked by inspection, by measurement and by fitting conductors of the smallest and largest nominal cross-sectional areas specified.

12.2.2 Terminals with screw clamping shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

NOTE The term "special preparation" covers soldering of the wires of the conductor, use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

12.2.3 Terminals with screw clamping shall have adequate mechanical strength.

Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.

Screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

Compliance is checked by inspection and by the tests of 12.2.6 and 12.2.8.

NOTE Provisionally SI, BA, and UN threads are considered to be comparable in pitch and mechanical strength to metric ISO thread.

12.2.4 Terminals with screw clamping shall be resistant to corrosion.

Terminals, the body of which is made of copper or copper alloy as specified in 26.5, are considered as complying with this requirement.

12.2.5 Terminals with screw clamping shall be so designed and constructed that they clamp the conductor(s) without undue damage to the conductor(s).

Compliance is checked by the following test.

The terminal is placed in the test apparatus according to figure 11 and fitted with rigid, solid, stranded and/or flexible conductor(s), according to table 3 first with the smallest and then with the largest nominal cross-sectional area, the clamping screw(s) or nut(s) being tightened with the torque according to table 6.

Where rigid stranded conductors do not exist, the test may be made with rigid solid conductors only. In this case, there is no need for further tests.

The length of the test conductor shall be 75 mm longer than the height (H) specified in table 9.

The end of the conductor is passed through an appropriate bushing in a plate positioned at a height (H) below the equipment, as given in table 9. The bushing is positioned in a horizontal plane such that its centre line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal plane; the platen is then rotated at a rate of (10 ± 2) r/min.

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ±15 mm of the height specified in table 9. The bushing may be lubricated to prevent binding, twisting, or rotation of the insulated conductor.

A mass as specified in table 9 is suspended from the end of the conductor. The duration of the test is approximately 15 min.

During the test, the conductor shall neither slip out of the clamping unit nor break near the clamping unit, nor shall the conductor be damaged in such a way as to render it unfit for further use.

The test shall be repeated with rigid solid conductors where they exist, if the first test has been made with rigid stranded conductors.

12.2.6 Terminals with screw clamping shall be so designed that they clamp the conductor reliably between metal surfaces.

Compliance is checked by inspection and by the following test.

The terminals are fitted with rigid solid or stranded conductors for fixed socket-outlets and flexible conductors for plugs and portable socket-outlets using conductors of the smallest and largest nominal cross-sectional area specified in table 3, the terminal screws being tightened with a torque equal to two-thirds of the torque shown in the appropriate column of table 6.

If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of the torque shown in column 3 of table 6.

Each conductor is then subjected to a pull as specified in table 4, applied without jerks, for 1 min, in the direction of the axis of the conductor space.

Table 4 – Values for pull test for screw-type terminals

Nominal cross-sectional area of conductors accepted by the terminal mm^2	**Pull** N
Above 0,75 up to 1,5 inclusive	40
Above 1,5 up to 2,5 inclusive	50
Above 2,5 up to 4 inclusive	50
Above 4 up to 6 inclusive	60
Above 6 up to 10 inclusive	80

If the clamp is provided for two or three conductors, the appropriate pull is applied consecutively to each conductor.

During the test, the conductor shall not move noticeably in the terminal.

12.2.7 Terminals with screw clamping shall be so designed or placed that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

Compliance is checked by the following test.

The terminals are fitted with conductors having the largest nominal cross-sectional area specified in table 3.

The terminals of fixed socket-outlets are checked both with rigid solid conductors and with rigid stranded conductors.

The terminals of plugs and portable socket-outlets are checked with flexible conductors.

Terminals intended for the looping-in of two or three conductors are checked, being fitted with the permissible number of conductors.

The terminals are fitted with conductors having the composition shown in table 5.

Table 5 – Composition of conductors

Nominal cross-sectional area	Number of wires (*n*) and nominal diameter of conductors *n* mm		
mm²	Flexible conductor	Rigid solid conductor	Rigid stranded conductor
0,75	24 0,20	–	–
1,0	32 0,20	1 1,13	7 0,42
1,5	30 0,25	1 1,38	7 0,52
2,5	50 0,25	1 1,78	7 0,67
4,0	56 0,30	1 2,25	7 0,86
6,0	84 0,30	1 2,76	7 1,05
10,0	–	1 3,57	7 1,35

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) conductors are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape and flexible conductors are twisted in one direction so that there is a uniform twist of one complete turn in a length of approximately 20 mm.

The conductor is inserted into the clamping means of the terminal for the minimum distance prescribed, or where no distance is prescribed, until it just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

The clamping screw is then tightened with a torque equal to two-thirds of the torque shown in the appropriate column of table 6.

For flexible conductors the test is repeated with a new conductor which is twisted as before, but in the opposite direction.

After the test, no wire of the conductors shall have escaped from the clamping unit thus reducing creepage distances and clearances to values lower than those indicated in table 23.

12.2.8 Terminals with screw clamping shall be so fixed or located within the accessory that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixing to accessories.

NOTE 1 These requirements do not imply that the terminals are designed so that their rotation or displacement is prevented, but any movement is sufficiently limited so as to prevent non-compliance with this standard.

NOTE 2 The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that

– the sealing compound or resin is not subject to stress during normal use, and

– the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this standard.

Compliance is checked by inspection, by measurement and by the following test.

A rigid solid copper conductor of the largest nominal cross-sectional area specified in table 3 is placed in the terminal.

Where rigid solid conductors do not exist, the test may be made with rigid stranded conductors.

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape.

The conductor is inserted into the clamping means of the terminal for the minimum distance prescribed, or where no distance is prescribed, until it just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

Screws and nuts are tightened and loosened five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to the torque shown in the appropriate column of table 6 or in the table of the appropriate figures 2, 3 or 4, whichever is the greater.

The conductor is moved each time the screw or nut is loosened.

Where a screw has a hexagonal head with a slot, only the test with the screwdriver is made with the torque values given in column 3.

Table 6 – Tightening torques for the verification of the mechanical strength of screw-type terminals

Nominal diameter of thread mm	**Torque** Nm		
	1 [a]	**2** [b]	**3** [c]
Up to and including 2,8	0,2	0,4	-
Over 2,8 up to and including 3,0	0,25	0,5	–
Over 3,0 up to and including 3,2	0,3	0,6	–
Over 3,2 up to and including 3,6	0,4	0,8	–
Over 3,6 up to and including 4,1	0,7	1,2	1,2
Over 4,1 up to and including 4,7	0,8	1,8	1,2
Over 4,7 up to and including 5,3	0,8	2,0	1,4

[a] Column 1 applies to screws without a head if the screw, when tightened, does not protrude from the hole and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

[b] Column 2 applies to other screws which are tightened by means of a screwdriver and to screws and nuts which are tightened by means other than a screwdriver.

[c] Column 3 applies to nuts of mantle terminals which are tightened by means of a screwdriver.

During the test, terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to heads, slots (rendering the use of the appropriate screwdriver impossible), threads, washers or stirrups that will impair the further use of the terminal.

NOTE 1 For mantle terminals the specified nominal diameter is that of the slotted stud.

NOTE 2 The shape of the blade of the test screwdriver should suit the head of the screw to be tested.

NOTE 3 The screws and nuts should not be tightened in jerks.

12.2.9 Clamping screws or nuts of earthing terminals with screw clamping shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of a tool.

Compliance is checked by manual test.

NOTE In general, the design of terminals shown in figures 2, 3, 4 and 5 provide sufficient resiliency to comply with this requirement; for other designs, special provisions, such as the use of an adequate resilient part which is not likely to be removed inadvertently, may be necessary.

12.2.10 Earthing terminals with screw clamping shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor, or any other metal that is in contact with these parts.

The body of the earthing terminal shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure, when the screw or nut shall be of brass or other metal no less resistant to corrosion.

If the body of the earthing terminal is a part of a frame or enclosure of aluminium alloy, precautions shall be taken to avoid the risk of corrosion resulting from contact between copper and aluminium or its alloys.

Compliance is checked by inspection.

NOTE Screws or nuts of plated steel withstanding the corrosion test are considered to be of a metal no less resistant to corrosion than brass.

12.2.11 For pillar terminals, the distance between the clamping screw and the end of the conductor, when fully inserted, shall be at least that specified in figure 2.

NOTE The minimum distance between the clamping screw and the end of the conductor applies only to pillar terminals in which the conductor cannot pass right through.

For mantle terminals, the distance between the fixed part and the end of the conductor, when fully inserted, shall be at least that specified in figure 5.

Compliance is checked by measurement, after a solid conductor of the largest nominal cross-sectional area specified in table 3, has been fully inserted and fully clamped.

12.3 Screwless terminals for external copper conductors

12.3.1 Screwless terminals may be of the type suitable for rigid copper conductors only or of the type suitable for both rigid and flexible copper conductors.

For the latter type the tests are carried out with rigid conductors first and then repeated with flexible conductors.

NOTE Subclause 12.3.1 is not applicable to socket-outlets provided with

– screwless terminals requiring the fixing of special devices to the conductors before clamping them in the screwless terminal, for example flat push-on connectors;

– screwless terminals requiring twisting of the conductors, for example, those with twisted joints;

– screwless terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.

12.3.2 Screwless terminals shall be provided with two clamping units each allowing the proper connection of rigid or of rigid and flexible copper conductors having nominal cross-sectional areas as shown in table 7.

Table 7 – Relationship between rated current and connectable cross-sectional areas of copper conductors for screwless terminals

Rated current A	Conductors		
	Nominal cross-sectional areas mm^2	Diameter of largest rigid conductor mm	Diameter of largest flexible conductor mm
From 10 up to 16 inclusive	From 1,5 up to 2,5 inclusive	2,13	2,21

When two conductors have to be connected, each conductor shall be introduced in a separate independent clamping unit (not necessarily in separate holes).

Compliance is checked by inspection and by fitting conductors of the smallest and largest nominal cross-sectional areas specified.

12.3.3 Screwless terminals shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

NOTE The term "special preparation" covers soldering of the wires of the conductor, use of terminal ends, etc., but not the reshaping of the conductor before introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

12.3.4 Parts of screwless terminals mainly intended to carry current shall be of materials as specified in 26.5.

Compliance is checked by inspection and by chemical analysis.

NOTE Springs, resilient units, clamping plates and the like are not considered as parts mainly intended to carry current.

12.3.5 Screwless terminals shall be so designed that they clamp the specified conductors with sufficient contact pressure and without undue damage to the conductor.

The conductor shall be clamped between metal surfaces.

NOTE Conductors are considered to be unduly damaged if they show appreciably deep or sharp indentations.

Compliance is checked by inspection and by the tests of 12.3.10.

12.3.6 It shall be clear how the connection and disconnection of the conductors is to be made.

The intended disconnection of a conductor shall require an operation, other than a pull on the conductor, so that it can be made manually with or without the help of a general purpose tool.

It shall not be possible to confuse the opening intended for the use of a tool to assist the connection or disconnection with the opening intended for the conductor.

Compliance is checked by inspection and by the tests of 12.3.10.

12.3.7 Screwless terminals which are intended to be used for the interconnection of two or more conductors shall be so designed that

– during the insertion, the operation of the clamping means of one of the conductors is independent of the operation of that of the other conductor(s);
– during the disconnection, the conductors can be disconnected either at the same time or separately;
– each conductor shall be introduced in a separate clamping unit (not necessarily in separate holes);
– it shall be possible to clamp securely any number of conductors up to the maximum as designed.

Compliance is checked by inspection and by manual tests with the appropriate conductors (in number and size).

12.3.8 Screwless terminals of fixed socket-outlets shall be designed so that adequate insertion of the conductor is obvious and over-insertion is prevented if further insertion is liable to reduce the creepage distances and/or clearances required in table 23, or to influence the operation of the socket-outlet.

NOTE For the purpose of this requirement, an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal may be put on the socket-outlet or given in an instruction sheet which accompanies the socket-outlet.

Compliance is checked by inspection and by the tests of 12.3.10.

12.3.9 Screwless terminals shall be properly fixed to the socket-outlet.

They shall not work loose when the conductors are connected or disconnected during installation.

Compliance is checked by inspection and by the tests of 12.3.10.

Covering with sealing compound without other means of locking is not sufficient. Self-hardening resins may, however, be used to fix terminals which are not subject to mechanical stress in normal use.

12.3.10 Screwless terminals shall withstand the mechanical stresses occurring in normal use.

Compliance is checked by the following tests which are carried out with uninsulated conductors on one screwless terminal of each specimen, using a new specimen for each test.

The test is carried out with solid rigid copper conductors, first with conductors having the largest nominal cross-sectional area, and then with conductors having the smallest nominal cross-sectional area specified in table 7.

Conductors are connected and disconnected five times, new conductors being used each time, except for the fifth time, when the conductors used for the fourth connection are clamped at the same place. For each connection, the conductors are either pushed as far as possible into the terminal or are inserted so that adequate connection is obvious.

After each connection, the conductor is subjected to a pull of the value shown in table 8; the pull is applied without jerks, for 1 min, in the direction of the longitudinal axis of the conductor space.

Table 8 – Value for pull test for screwless-type terminals

Rated current A	**Pull** N
10 up to and including 16	30

During the application of the pull, the conductor shall not come out of the screwless terminal.

The test is then repeated with rigid stranded copper conductors having the largest and smallest nominal cross-sectional areas specified in 12.3.2; these conductors are, however, connected and disconnected only once.

Screwless terminals intended for both rigid and flexible conductors shall also be tested with flexible conductors, making five connections and disconnections.

For fixed socket-outlets with screwless terminals, each conductor is subjected for 15 min to a circular motion with (10 ± 2) r/min using an apparatus, an example of which is shown in figure 11. During this test, a mass as specified in table 9 is suspended from the end of the conductor.

Table 9 – Values for flexing under mechanical load test for copper conductors

Nominal cross-sectional area of conductor[a] mm^2	**Diameter of bushing hole**[b] mm	**Height *H*** mm	**Mass for conductor** kg
0,5	6,5	260	0,3
0,75	6,5	260	0,4
1,0	6,5	260	0,4
1,5	6,5	260	0,4
2,5	9,5	280	0,7
4,0	9,5	280	0,9
6,0	9,5	280	1,4
10,0	9,5	280	2,0

[a] Approximate relationship between mm^2 and AWG sizes can be found in IEC 60999-1.

[b] If the bushing-hole diameter is not large enough to accommodate the conductor without binding, a bushing having the next larger hole size may be used.

During the test, the conductors shall not move noticeably in the clamping unit.

After these tests, neither the terminals nor the clamping means shall have worked loose and the conductors shall show no deterioration impairing their further use.

12.3.11 Screwless terminals shall withstand the electrical and thermal stresses occurring in normal use.

Compliance is checked by the following tests a) and b), which are carried out on five screwless terminals of socket-outlets which have not been used for any other test.

Both tests are carried out with new copper conductors.

a) *The test is carried out loading the screwless terminals for 1 h with an alternating current as specified in table 10 and connecting rigid solid conductors 1 m long having the nominal cross-sectional area as specified in the same table.*

The test is carried out on each clamping unit.

Table 10 – Test current for the verification of electrical and thermal stresses in normal use for screwless terminals

Rated current A	**Test current** A	**Nominal cross-sectional area of the conductor** mm²
10	17,5	1,5
16	22	2,5
NOTE For socket-outlets having rated currents lower than 10 A, the test current is proportionally determined and the cross-sectional area of the conductors is 1,5 mm².		

During the test the current is not passed through the socket-outlet, but only through the terminals.

Immediately after this period, the voltage drop across each screwless terminal is measured with rated current flowing.

In no case shall the voltage drop exceed 15 mV.

The measurements are made across each screwless terminal and as near as possible to the place of contact.

If the back connection of the terminal is not accessible, the specimens may be adequately prepared by the manufacturer; care shall be taken not to affect the behaviour of the terminals.

Care shall be taken to ensure that, during the period of the test, including the measurements, the conductors and the measurement devices are not moved noticeably.

b) *The screwless terminals already subjected to the determination of the voltage drop specified in the previous test a) are tested as follows.*

During the test, a current equal to the test current value given in table 10 is passed.

The whole test arrangement, including the conductors, shall not be moved until the measurements of the voltage drop have been completed.

The terminals are subjected to 192 temperature cycles, each cycle having a duration of approximately 1 h and carried out as follows:

– *the current flows for approximately 30 min;*

– *for a further period of approximately 30 min no current flows.*

The voltage drop in each screwless terminal is determined as prescribed for the test of a) after every 24 temperature cycles and after the 192 temperature cycles have been completed.

In no case shall the voltage drop exceed 22,5 mV or twice the value measured after the 24th cycle, whichever is the smaller.

After this test an inspection by normal or corrected vision without additional magnification shall show no changes evidently impairing further use such as cracks, deformations or the like.

In addition, the mechanical strength test according to 12.3.10 is repeated and all specimens shall withstand this test.

12.3.12 Screwless terminals shall be so designed that the connected rigid solid conductor remains clamped, even when it has been deflected during normal installation, for example, during mounting in a box, and the deflecting stress is transferred to the clamping unit.

Compliance is checked by the following test which is made on three specimens of socket-outlets which have not been used for any other test.

The test apparatus, the principle of which is shown in figure 12a, shall be so constructed that

– *a specified conductor properly inserted into a terminal is allowed to be deflected in any of the 12 directions differing from each other by 30°, with a tolerance referred to each direction of ±5°, and*

– *the starting point can be varied by 10° and 20° from the original point.*

NOTE 1 A reference direction need not be specified.

The deflection of the conductor from its straight position to the testing positions shall be effected by means of a suitable device, applying a specified force to the conductor at a certain distance from the terminal.

The deflecting device shall be so designed that

– *the force is applied in a direction perpendicular to the undeflected conductor;*

– *the deflection is attained without rotation or displacement of the conductor within the clamping unit;*

– *the force remains applied while the prescribed voltage drop measurement is made.*

Provisions shall be made so that the voltage drop across the clamping unit under test can be measured when the conductor is connected, as shown for example in figure 12b.

The specimen is mounted on the fixed part of the test apparatus in such a way that the specified conductor inserted into the clamping unit under test can be freely deflected.

NOTE 2 If necessary, the inserted conductor may be permanently bent around obstacles so that these do not influence the results of the test.

NOTE 3 In some cases, with the exception of the case of guidance for the conductor, it may be advisable to remove those parts of the specimens which do not allow the deflection of the conductor corresponding to the force to be applied.

To avoid oxidation, the insulation shall be removed from the conductor immediately before starting the test.

A clamping unit is fitted as for normal use with a rigid solid copper conductor having the smallest nominal cross-sectional area specified in table 11 and is submitted to a first test sequence; the same clamping unit is submitted to a second test sequence using the conductor having the largest nominal cross-sectional area, unless the first test sequence has failed.

The force for deflecting the conductor is specified in table 12, the distance of 100 mm being measured from the extremity of the terminal, including the guidance, if any, for the conductor, to the point of application of the force to the conductor.

The test is made with continuous current (i.e. the current is not switched on and off during the test); a suitable power supply should be used and an appropriate resistance should be inserted in the circuit so that the current variations are kept within ±5 % during the test.

Table 11 – Nominal cross-sectional areas of rigid copper conductors for deflection test of screwless terminals

Rated current of the socket-outlet A	**Nominal cross-sectional area of the test conductor** mm^2	
	First test sequence	**Second test sequence**
Up to and including 6	1,0 [a]	1,5
Above 6 up to and including 16	1,5	2,5
[a] Only for countries allowing the use of 1,0 mm^2 conductors in fixed installations		

Table 12 – Deflection test forces

Nominal cross-sectional area of the test conductor mm^2	**Force for deflecting the test conductor** [a] N
1,0	0,25
1,5	0,5
2,5	1,0
[a] The forces are chosen so that they stress the conductors close to the limit of elasticity.	

A test current equal to the rated current of the socket-outlet is passed through the clamping unit under test. A force according to table 12 is applied to the test conductor inserted in the clamping unit under test in one of the 12 directions shown in figure 12a and the voltage drop across this clamping unit is measured. The force is then removed.

The force is then applied successively on each one of the remaining 11 directions shown in figure 12a, following the same test procedure.

If, for any of the 12 test directions, the voltage drop is greater than 25 mV, the force is maintained in this direction until the voltage drop is reduced to a value below 25 mV, but for not more than 1 min. After the voltage drop has reached a value below 25 mV, the force is maintained in the same direction for a further period of 30 s during which period the voltage drop shall not have increased.

The other two specimens of socket-outlets of the set are tested following the same test procedure, but moving the 12 directions of the force so that they differ by approximately 10° for each specimen.

If one specimen has failed at one of the directions of application of the test force, the tests are repeated on another set of specimens, all of which shall comply with this new series of tests.

13 Construction of fixed socket-outlets

13.1 Socket-contact assemblies shall have sufficient resilience to ensure adequate contact pressure on plug pins.

Compliance is checked by inspection and the tests of clauses 9, 21 and 22.

13.2 Socket-contacts and pins of socket-outlets shall be resistant to corrosion and abrasion.

Compliance is checked by inspection and the tests of 26.5.

13.3 Insulating linings, barriers and the like shall have adequate mechanical strength.

Compliance is checked by inspection and by the tests of clause 24.

13.4 Socket-outlets shall be so constructed as to permit

– easy introduction and connection of the conductors in the terminals;
– easy fixing of the base to a wall or in a mounting box;
– correct positioning of the conductors;
– adequate space between the underside of the base and the surface on which the base is mounted or between the sides of the base and the enclosure (cover or box) so that, after installation of the socket-outlet, the insulation of the conductors is not necessarily pressed against live parts of different polarity.

NOTE This requirement does not imply that the metal parts of the terminal are necessarily protected by insulating barriers or insulating shoulders, to avoid contact due to incorrect installation of the terminal metal parts, with the insulation of the conductor.

For surface type socket-outlets to be mounted on a mounting plate, a wiring channel may be needed to comply with this requirement.

In addition, socket-outlets classified as design A shall permit easy positioning and removal of the cover or cover-plate, without displacing the conductors.

Compliance is checked by inspection and by an installation test with conductors of the largest nominal cross-sectional area specified in table 3.

13.5 Socket-outlets shall be so designed that full engagement of associated plugs is not prevented by any projection from their engagement face.

Compliance is checked by determining that the gap between the engagement face of the socket-outlet and the plug does not exceed 1 mm when the plug is inserted into the socket-outlet as far as it will go.

13.6 If covers are provided with bushings for the entry holes for the pins, it shall not be possible to remove them from the outside or for them to become detached inadvertently from the inside when the cover is removed.

Compliance is checked by inspection and, if necessary, by manual test.

13.7 Covers, cover-plates or parts of them which are intended to ensure protection against electric shock shall be held in place at two or more points by effective fixings.

Covers, cover-plates or parts of them may be fixed by means of a single fixing, for example, by a screw, provided that they are located by another means (for example, by a shoulder).

NOTE 1 It is recommended that the fixings of covers or cover-plates be captive. The use of tight-fitting washers of cardboard or the like is deemed to be an adequate method for securing screws intended to be captive.

NOTE 2 Non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values specified in table 23, are not considered as accessible if the requirements of this subclause are met.

Where the fixings of covers or cover-plates of socket-outlets of design A serve to fix the base, there shall be means to maintain the base in position, even after removal of the covers or cover-plates.

Compliance is checked by the tests of 13.7.1, 13.7.2 or 13.7.3.

13.7.1 *For covers or cover-plates whose fixings are of the screw-type:*

by inspection only.

13.7.2 *For covers or cover-plates whose fixing is not dependent on screws and whose removal is obtained by applying a force in a direction approximately perpendicular to the mounting/supporting surface (see table 13):*

– *when their removal may give access, with the standard test finger, to live parts:*

by the tests of 24.14;

– *when their removal may give access, with the standard test finger, to non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values shown in table 23:*

by the tests of 24.15;

– *when their removal may give access, with the standard test finger, only to*
  - ∞ *parts of insulating material, or*
  - ∞ *earthed metal parts, or*
  - ∞ *metal parts separated from live parts in such a way that creepage distances and clearances have twice the values shown in table 23, or*
  - ∞ *live parts of SELV circuits not greater than 25 V a.c.:*

by the tests of 24.16.

Table 13 – Forces to be applied to covers, cover-plates or actuating members whose fixing is not dependent on screws

Accessibility with the standard test finger after removal of covers, cover-plates or parts of them	Tests according to subclauses	Force to be applied N			
		Number of socket-outlets complying with 24.17 and 24.18 which		Number of socket-outlets not complying with 24.17 and 24.18 which	
		shall not come off	shall come off	shall not come off	shall come off
To live parts	24.14	40	120	80	120
To non-earthed metal parts separated from live parts by creepage distances and clearances according to table 23	24.15	10	120	20	120
To insulating parts, earthed metal parts, live parts of SELV 25 V a.c. or metal parts separated from live parts by creepage distances twice those according to table 23	24.16	10	120	10	120

13.7.3 *For covers or cover-plates the fixing of which is not dependent on screws and whose removal is obtained by using a tool, in accordance with the manufacturer's instructions given in an instruction sheet or in other documentation:*

by the same tests of 13.7.2 except that the covers or cover-plates or parts of them need not come off when applying a force not exceeding 120 N in directions perpendicular to the mounting/supporting surface.

13.8 A cover-plate intended for a socket-outlet with earthing contact shall not be interchangeable with a cover-plate intended for a socket-outlet without earthing contact, if such interchange results in a change of the classification of the socket-outlet according to 7.1.3.

NOTE This requirement applies to accessories of the same manufacturer.

Compliance is checked by inspection and by an installation test.

13.9 Surface-type socket-outlets shall be so constructed that, when they are fixed and wired as for normal use, there are no free openings in their enclosures other than the entry openings for the pins of the plug or other openings for contacts, for example, side earthing contacts, or locking devices, etc.

Drain holes, small gaps between enclosures or boxes and conduits, cables, or earthing contacts (if any), or between enclosures or boxes and grommets or membranes and knockouts are ignored.

Compliance is checked by inspection and by an installation test using a cable having conductors of the smallest nominal cross-sectional area specified in table 14.

13.10 Screws or other means for mounting the socket-outlet on a surface in a box or enclosure shall be easily accessible from the front. These means shall not serve any other fixing purpose.

13.11 Multiple socket-outlets with a common base shall be provided with fixed links for the interconnection of the contacts in parallel. The fixing of these links shall be independent from the connection of the supply wires.

13.12 Multiple socket-outlets, comprising separate bases, shall be so designed that the correct position of each base is ensured. The fixing of each base shall be independent of the fixing of the combination to the mounting surface.

Compliance with the requirements of 13.10 to 13.12 is checked by inspection.

13.13 The mounting plate of surface-type socket-outlets shall have adequate mechanical strength.

Compliance is checked by inspection after the test of 13.4 and by the test of 24.3.

13.14 Socket-outlets shall withstand the lateral strain imposed by equipment likely to be introduced into them.

For socket-outlets having ratings up to and including 16 A and 250 V, compliance is checked by means of the device shown in figure 13.

Each specimen is mounted on a vertical surface with the plane through the socket-contacts horizontal. The device is then fully engaged and a weight hung on it such that the force exerted is 5 N.

The device is removed after 1 min and the socket-outlet is turned through 90° on the mounting surface. The test is made four times, the socket-outlet being turned through 90° after each engagement.

During the test the device shall not become disengaged from the socket-outlet.

After the tests, the socket-outlets shall show no damage within the meaning of this standard; in particular, they shall comply with the requirements of clause 22.

NOTE Other socket-outlets are not tested.

13.15 Socket-outlets shall not be an integral part of lampholders.

Compliance is checked by inspection.

13.16 Surface-type socket-outlets having an IP code higher than IP20 shall be according to their IP classification when fitted with conduits or with sheathed cables as for normal use and without a plug in engagement.

Surface-type socket-outlets having degrees of protection IPX4 and IPX5 shall have provision for opening a drain hole.

If a socket-outlet has a drain hole, it shall be not less than 5 mm in diameter, or 20 mm^2 in area with a width and a length of not less than 3 mm.

If the position of the lid is such that only one mounting position is possible, the drain hole shall be effective in that position. Alternatively, the drain hole(s) shall be effective in at least two positions of the socket-outlet when this is mounted on a vertical wall, one of these with the conductors entering at the top and the other with the conductors entering at the bottom.

Lid springs, if any, shall be of corrosion-resistant material, such as bronze or stainless steel.

Compliance is checked by inspection, by measurement and by the relevant tests of 16.2.

NOTE 1 Adequate enclosure when the plug is not in position may be achieved by means of a lid.

NOTE 2 This requirement does not imply that the lid, if any, or the entry openings for the pins need be closed when the plug is not in position, provided that socket-outlets pass the relevant test for the verification of the ingress of water.

NOTE 3 A drain hole in the back of the enclosure is deemed to be effective only if the design of the enclosure ensures a clearance of at least 5 mm from the mounting surface or provides a drainage channel of at least the size specified.

13.17 Earthing pins shall have adequate mechanical strength.

Compliance is checked by inspection and, for pins which are not solid, by the test of 14.2 which is made after the tests of clause 21.

13.18 Earthing contacts and neutral contacts shall be locked against rotation and removable only with the aid of a tool, after dismantling the socket-outlet.

Compliance is checked by inspection and by manual test.

NOTE A design permitting the removal of a contact without the aid of a tool, after removal of an enclosure requiring the use of a tool, is not allowed.

13.19 Metal strips of the earthing circuit shall have no burrs which might damage the insulation of the supply conductors.

Compliance is checked by inspection.

13.20 Socket-outlets to be installed in a box shall be so designed that the conductor ends can be prepared after the box is mounted in position, but before the socket-outlet is fitted in the box.

Compliance is checked by inspection.

13.21 Inlet openings shall allow the introduction of the conduit or the sheath of the cable so as to afford complete mechanical protection.

Surface-type socket-outlets shall be so constructed that the conduit or sheath of the cable can enter at least 1 mm into the enclosure.

In surface-type socket-outlets the inlet opening for conduit entries, or at least two of them if there are more than one, shall be capable of accepting conduit sizes of 16, 20, 25 or 32 according to IEC 60423 or a combination of at least two of any of these sizes.

In surface-type socket-outlets, the inlet opening for cable entries will preferably be capable of accepting cables having the dimensions specified in table 14 or be as specified by the manufacturer.

Table 14 – External cable dimension limits for surface-type socket-outlets

Rated current A	Nominal cross-sectional areas of conductors mm²	Number of conductors	Limits of external dimensions of cables mm	
			Minimum	Maximum
10	1 up to and including 2,5	2	6,4	13,5
		3		14,5
16	1,5 up to and including 2,5	2	7,4	13,5
		3		14,5
	1,5 up to and including 4	4	7,6	18
		5		19,5
32	2,5 up to and including 10	2	8,9	24
		3		25,5
		4		28
		5		30,5
NOTE The limits of external dimensions of cables specified are based on IEC 60227 and IEC 60245.				

Compliance is checked by inspection and by measurement.

NOTE Inlet openings of adequate size may also be obtained by the use of knock-outs or of suitable insertion pieces.

13.22 Membranes (grommets) in inlet openings shall be reliably fixed and shall not be displaced by the mechanical and thermal stresses occurring in normal use.

Compliance is checked by inspection and by the following test.

Membranes are tested when assembled in the accessory.

First the accessories are fitted with membranes which have been subjected to the treatment specified in 16.1.

The accessories are then placed for 2 h in a heating cabinet as described in 16.1, the temperature being maintained at (40 ± 2) °C.

Immediately after this period, a force of 30 N is applied for 5 s to various parts of the membranes by means of the tip of a straight unjointed test finger (test probe 11 of IEC 61032).

During these tests, the membranes shall not deform to such an extent that live parts become accessible.

For membranes likely to be subjected to an axial pull in normal use, an axial pull of 30 N is applied for 5 s.

During this test, the membranes shall not become detached.

The test is then repeated with membranes which have not been subjected to any treatment.

13.23 It is recommended that membranes in inlet openings be so designed and made of such material that the introduction of the cables into the accessory is permitted when the ambient temperature is low.

NOTE In the following countries compliance with this recommendation is required due to installation practices in cold conditions: AT, CA, CH, CZ, DK, FI, NO, SE.

When required, compliance is checked by the following test.

The accessories are fitted with membranes which have not been subjected to ageing treatment, those without openings being suitably pierced.

The accessories are then kept for 2 h in a freezer at a temperature of (–15 ± 2) °C.

After this period, the accessories are removed from the freezer and immediately afterwards, while the accessories are still cold, it shall be possible to introduce, without undue force, cables of the largest diameter through the membranes.

After the tests of 13.22 and 13.23 the membranes shall show no harmful deformation, cracks or similar damage which would lead to non-compliance with this standard.

14 Construction of plugs and portable socket-outlets

14.1 Non-rewirable portable accessories shall be such that

– the flexible cable cannot be separated from the accessory without making it permanently useless, and
– the accessory cannot be opened by hand or by using a general purpose tool, for example, a screwdriver used as such.

NOTE An accessory is considered to be permanently useless, when for re-assembling the accessory, parts or materials other than the original are to be used.

Compliance is checked by inspection, by manual test and by the test of 24.14.3.

14.2 Pins of portable accessories shall have adequate mechanical strength.

Compliance is checked by the test of clause 24 and, for pins which are not solid, by the following test which is made after the test of clause 21.

A force of 100 N is exerted on the pin, which is supported as shown in figure 14, for 1 min in a direction perpendicular to the axis of the pin, by means of a steel rod having a diameter of 4,8 mm, the axis of which is also perpendicular to the axis of the pin.

During the application of the force, the reduction of the dimension of the pin at the point where the force is applied shall not exceed 0,15 mm.

After removal of the rod, the dimensions of the pin shall not have changed by more than 0,06 mm in any direction.

14.3 Pins of plugs shall be

– locked against rotation,
– not removable without dismantling the plug,
– adequately fixed in the body of the plug when the plug is wired and assembled as for normal use.

It shall not be possible to arrange the earthing or neutral pins or contacts of plugs in an incorrect position.

Compliance is checked by inspection, by manual test and by the tests of 24.2 and 24.10.

14.4 Earthing contacts and neutral contacts of portable socket-outlets shall be locked against rotation and removable only with the aid of a tool, after dismantling the socket-outlet.

Compliance is checked by inspection, by manual test and, for single portable socket-outlets, by the test of 24.2.

14.5 Socket-contact assemblies shall have sufficient resilience to ensure adequate contact pressure.

This requirement may also cover socket-outlets where the contact pressure relies on insulating parts having such characteristics as to ensure a safe and permanent contact in any condition of normal use, with regard in particular to shrinkage, ageing and yielding.

Compliance is checked by inspection and by the tests of 9, 21 and 22.

14.6 Pins and socket-contacts shall be resistant to corrosion and abrasion.

Compliance is checked by an appropriate test, which is under consideration.

14.7 The enclosures of rewirable portable accessories shall completely enclose the terminals and the ends of flexible cable.

The construction shall be such that the conductors can be properly connected and that, when the accessory is wired and assembled as for normal use, there is no risk that

– pressing the cores together causes damage to the conductor insulation likely to result in a breakdown of the insulation;
– a core, the conductor of which is connected to a live terminal is not necessarily pressed against accessible metal parts;
– a core, the conductor of which is connected to an earthing terminal is not necessarily pressed against live parts.

14.8 Rewirable portable accessories shall be designed in such a way that terminal screws or nuts cannot become loose and fall out of position in such a way that they establish an electrical connection between live parts and the earthing terminal or metal parts connected to the earthing terminal.

Compliance with the requirements of 14.7 and 14.8 is checked by inspection and by manual test.

14.9 Rewirable portable accessories with earthing contact shall be designed with ample space for slack in the earthing conductor so that, if the strain relief is rendered inoperative, the connection of the earthing conductor is subjected to strain after the connections of the current-carrying conductors and, in case of excessive stress, the earthing conductor will break after the current-carrying conductors.

Compliance is checked by the following test.

The current-carrying conductors of a flexible cable are connected to the accessory in such a way that they are led from the strain relief to the corresponding terminals along the shortest possible path. Following which, the core of the earthing conductor is led to its terminal and cut off at a distance 8 mm longer than necessary when using the shortest possible path for its correct connection.

The earthing conductor is then connected to the terminal. It shall then be possible to house the loop, which is formed by the earthing conductor owing to its surplus length when the accessory is assembled correctly.

In non-rewirable non-moulded-on accessories with earthing contact, the length of the conductors between the terminations and the cord anchorage shall be adjusted in such a way that the current-carrying conductors will be stressed before the earthing conductor, if the flexible cable slips in its anchorage.

Compliance is checked by inspection.

14.10 Terminals of rewirable portable accessories and terminations of non-rewirable portable accessories shall be located or shielded in such a way that loose wires from a conductor in the accessory will not present a risk of electric shock.

For non-rewirable moulded-on portable accessories, means shall be provided to prevent loose wires of a conductor from reducing the minimum isolation distance requirements between such wires and all accessible external surfaces of the accessory, with the exception of the engagement face of a plug.

Compliance is checked by the following:

– *for rewirable accessories, the test of 14.10.1;*
– *for non-rewirable non-moulded-on accessories, the test of 14.10.2;*
– *for non-rewirable moulded-on accessories, by verification and inspection according to 14.10.3.*

14.10.1 *A 6 mm length of insulation is removed from the end of a flexible conductor, having the minimum required nominal cross-sectional area specified in table 3. One wire of the flexible conductor is left free and the remaining wires are fully inserted into and clamped in the terminal as for normal use.*

The free wire is bent, without tearing the insulation back, in every possible direction, but without making sharp bends around barriers.

NOTE The prohibition against making sharp bends around barriers does not imply that the free wire has to be kept straight during the test. Sharp bends are, moreover, made if it is considered likely that such bends may occur during the normal assembly of the plug or portable socket-outlet, for example when a cover is pushed on.

The free wire of a conductor connected to a live terminal shall not touch any accessible metal part or be able to emerge from the enclosure when the accessory has been assembled.

The free wire of a conductor connected to an earthing terminal shall not touch a live part.

If necessary, the test is repeated with the free wire in another position.

14.10.2 *A length of insulation equivalent to the maximum designed stripping length declared by the manufacturer plus 2 mm is removed from the end of a flexible conductor having the cross-sectional area as fitted. One wire of the flexible conductor is left free in the worst position whilst the remaining wires are terminated in a manner as used in the construction of the accessory.*

The free wire is bent, without tearing the insulation back, in every possible direction but without making sharp bends around barriers.

NOTE The prohibition against making sharp bends around barriers does not imply that the free wire has to be kept straight during the test. Sharp bends are, moreover, made if it is considered likely that such bends may occur during the normal assembly of the plug or portable socket-outlet, for example, when a cover is pushed on.

The free wire of a conductor connected to a live termination shall not touch any accessible metal part or reduce the creepage distance and clearance through any constructional gap below 1,5 mm to the external surface.

The free wire of a conductor connected to an earth termination shall not touch any live part.

14.10.3 *Non-rewirable moulded-on accessories shall be inspected to verify that there are means to prevent stray wires of the conductor and/or live parts reducing the minimum distance through insulation to the external accessible surface below 1,5 mm (with the exception of the engagement face of plugs).*

NOTE The verification of "means" may require the checking of the product construction or assembly method.

14.11 For rewirable portable accessories:

– it shall be clear how the relief from strain and the prevention of twisting is intended to be effected;
– the cord anchorage, or at least part of it, shall be integral with or fixed to one of the component parts of the plug or portable socket-outlet;
– makeshift methods, such as tying the flexible cable in a knot or tying the ends with string, shall not be used;
– the cord anchorage shall be suitable for the different types of flexible cable which may be connected to it;
– screws, if any, which have to be operated to clamp the flexible cable, shall not serve to fix any other component;

  NOTE This does not exclude a cover serving to retain the flexible cable in position in the cord anchorage provided the cable remains in place in the accessory when the cover is removed.

– cord anchorages shall be of insulating material or be provided with an insulating lining fixed to the metal parts;
– metal parts of cord anchorages, including clamping screws, shall be insulated from the earthing circuit.

Compliance is checked by inspection and, if applicable, by manual test.

14.12 For rewirable portable accessories and non-rewirable non-moulded on portable accessories it shall not be possible to remove covers, cover-plates or parts of them intended to ensure protection against electric shock without the use of a tool.

Compliance is checked as follows:

– *for covers, cover-plates or parts of them whose fixing is of screw-type, compliance is checked by inspection;*

– *for covers, cover-plates or parts of them whose fixing is not dependent on screws and whose removal may give access to live parts, compliance is checked by the tests of 24.14.*

14.13 If covers of portable socket-outlets are provided with bushings for the entry holes for the pins, these bushes shall not be removable from the outside or detachable inadvertently from the inside, when the cover is removed.

14.14 Screws intended to allow access to the interior of the accessory shall be captive.

NOTE The use of tight-fitting washers of cardboard or the like is deemed to be an adequate method for making screws captive.

Compliance with the requirements of 14.13 and 14.14 is checked by inspection.

14.15 The engagement face of plugs shall have no projections other than the pins, when the plug is wired and assembled as for normal use.

Compliance is checked by inspection, after fitting conductors of the largest nominal cross-sectional area specified in table 3.

NOTE The earthing contacts are not considered as projections from the engagement face.

14.16 Portable socket-outlets shall be designed in such a way that full engagement of associated plugs is not prevented by any projection from their engagement face.

Compliance is checked by the test of 13.5.

14.17 Portable accessories of IP code higher than IP20 shall be enclosed according to their IP classification when they are fitted with cables.

Plugs having an IP code higher than IP20, with the exception of the engagement face, shall be adequately enclosed when fitted with a flexible cable as for normal use.

Portable socket-outlets having an IP code higher than IP20 shall be adequately enclosed when fitted with a flexible cable as for normal use and without a plug in engagement.

Lid springs, if any, shall be made of corrosion-resistant material, such as bronze or stainless steel.

Compliance is checked by inspection and by the tests of 16.2.

NOTE Adequate enclosure when the plug is not in position may be achieved by means of a lid.

This requirement does not imply that the lid, if any, or the entry openings for the pins need be closed when the plug is not in position, provided that the accessory passes the relevant test for the verification of the ingress of water.

14.18 Portable socket-outlets having means for suspension from a wall or other mounting surfaces shall be so designed that the suspension means do not allow access to live parts.

There shall be no free openings between the space intended for the suspension means, by which the socket-outlet is fixed to the wall, or other mounting surface and live parts.

Compliance is checked by inspection and by the tests of 24.11, 24.12 and 24.13.

14.19 Combinations of portable accessories and switches, circuit-breakers or other devices shall comply with the relevant individual IEC standards, if a relevant combined product standard does not exist.

Compliance is checked, by testing the components according to the relevant IEC standard.

NOTE For combination with RCDs, see IEC 61540.

14.20 Portable accessories shall not be an integral part of lampholders.

Compliance is checked by inspection.

14.21 Plugs classified exclusively as plugs for equipment of class II may be rewirable or non-rewirable.

If they are part of a cord set, this shall be provided with a connector for equipment of class II.

If they are part of a cord extension set, this shall be provided with a portable socket-outlet for equipment of class II.

NOTE 1 In the following countries rewirable plugs for class II equipment are not allowed: AT, CH, CZ, DE, FI, NL, NO, SK.

NOTE 2 In the following countries cord extension sets for equipment of class II are not allowed: CZ, DE, DK, IT, SK, UK.

14.22 Components, such as switches and fuses, incorporated in accessories shall comply with the relevant IEC standard as far as it reasonably applies.

Compliance is checked by inspection and, if necessary, by testing the component according to the relevant IEC standard.

14.23 If a plug is an integral part of plug-in equipment, that equipment shall not cause overheating of the pins or impose undue strain on fixed socket-outlets.

NOTE 1 Examples of equipment with plugs which are an integral part are razors and lamps with rechargeable batteries, plug-in transformers, etc.

Plugs having a rating above 16 A and 250 V shall not be an integral part of other equipment.

For two-pole plugs, with or without earthing contact, having ratings up to and including 16 A and 250 V, compliance is checked by the tests of 14.23.1 and 14.23.2.

NOTE 2 For other plugs, tests are under consideration.

14.23.1 *The plug of the equipment is inserted into a fixed socket-outlet complying with this standard, the socket-outlet being connected to a supply voltage equal to 1,1 times the highest rated voltage of the equipment.*

After 1 h, the temperature rise of the pins shall not exceed 45 K.

14.23.2 *The equipment is inserted into a fixed socket-outlet complying with this standard, the socket-outlet is pivoted about a horizontal axis through the axis of the live socket-contacts at a distance of 8 mm behind the engagement face of the socket-outlet and parallel to this engagement face.*

The additional torque which has to be applied to the socket-outlet in order to maintain the engagement face in the vertical plane shall not exceed 0,25 Nm.

14.24 Plugs shall be shaped in such a way and made of such material that they can easily be withdrawn by hand from the relevant socket-outlet.

In addition, the gripping surfaces shall be designed in such a way that the plug can be withdrawn without having to pull on the flexible cable.

Compliance is checked by a test which is under consideration.

14.25 Membranes in inlet openings of portable accessories shall meet the requirements of 13.22 and 13.23.

15 Interlocked socket-outlets

Socket-outlets interlocked with a switch shall be constructed in such a way that a plug cannot be inserted into or completely withdrawn from the socket-outlet while the socket-contacts are live, and the socket-contacts of the socket-outlet cannot be made live until a plug is almost completely in engagement.

Compliance is checked by inspection and by manual test.

NOTE Other test requirements are specified in IEC 60884-2-6.

16 Resistance to ageing, protection provided by enclosures, and resistance to humidity

16.1 Resistance to ageing

Accessories shall be resistant to ageing.

Parts intended for decorative purposes only, such as certain lids, shall be removed if possible and these parts are not subjected to the test.

Compliance is checked by the following test.

Accessories, mounted as for normal use, are subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation.

Accessories having an IP code higher than IPX0 are tested after having been mounted and assembled as specified in 16.2.

The temperature in the cabinet is (70 ± 2) °C.

The specimens are kept in the cabinet for seven days (168 h).

The use of an electrically heated cabinet is recommended.

Natural circulation may be provided by holes in the wall of the cabinet.

After the treatment, the specimens are removed from the cabinet and kept at a room temperature and relative humidity between 45 % and 55 % for at least four days (96 h).

The specimens shall show no crack visible with normal or corrected vision without additional magnification, nor shall the material have become sticky or greasy, this being judged as follows:

- *with the forefinger wrapped in a dry piece of rough cloth the specimen is pressed with a force of 5 N;*
- *no traces of the cloth shall remain on the specimen and the material of the specimen shall not stick to the cloth.*

After the test, the specimens shall show no damage which would lead to non-compliance with this standard.

NOTE The force of 5 N can be obtained in the following way:

- the specimen is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the specimen plus 500 g;
- equilibrium is then restored by pressing the specimen with the forefinger, wrapped in a dry piece of rough cloth.

16.2 Protection provided by enclosures

Enclosures shall provide protection against access to hazardous parts, harmful effects due to ingress of solid foreign objects and harmful effects due to ingress of water in accordance with the IP designation of the accessory.

Compliance is checked by the tests of 16.2.1 and 16.2.2.

16.2.1 Protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects

Accessories and their enclosures shall provide a degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects.

Fixed socket-outlets are mounted as in normal use on a vertical surface. Flush-type and semi-flush type socket-outlets are mounted in an appropriate box according to the manufacturer´s instructions.

Accessories with screwed glands or membranes are fitted and connected with cables which shall be within the connecting range specified in table 3. Glands are tightened with a torque equal to two-thirds of that applied during the test of 24.6.

Screws of the enclosure are tightened with a torque equal to two-thirds of the value given in table 6.

Parts which can be removed without the aid of a tool are removed.

If an accessory has passed the test successfully, then this test is deemed to be passed for a combination of such single accessories.

NOTE Glands are not filled with sealing compound or the like.

16.2.1.1 Protection against access to hazardous parts

The appropriate test specified in IEC 60529 is performed (see also clause 10).

16.2.1.2 Protection against harmful effects due to ingress of solid foreign objects

The appropriate test specified in IEC 60529 is performed.

For the test of accessories with numeral 5 as the first characteristic, the accessories are considered to be of category 2; dust shall not penetrate in a quantity to interfere with satisfactory operation or to impair safety.

The test probes shall not be applied to drain holes.

16.2.2 Protection against harmful effects due to ingress of water

Accessories and their enclosures shall provide a degree of protection against harmful effects due to ingress of water in accordance with their IP classification.

Compliance is checked by the appropriate tests of IEC 60529 under the conditions specified below.

Flush-type and semi flush-type socket-outlets are fixed in a vertical test wall representing the intended use of the accessory using an appropriate box in accordance with the manufacturer's instructions.

Where the manufacturer's instructions specify that the accessory is suitable to be installed on a rough wall the test wall according to figure 15 is used. It is made with bricks having flat smooth surfaces. When the box is mounted in the test wall, it shall fit tight against the wall.

NOTE 1 If sealing material is used in order to seal the box into the wall, it should not influence the sealing properties of the specimen to be tested.

NOTE 2 Figure 15 shows an example where the edge of the box is positioned in the reference plane; other positions are possible, according to the manufacturer's instructions.

Surface type socket-outlets are mounted as for normal use in a vertical position and fitted with cables or conduits or both in accordance with the manufacturer's instructions. Cables shall have conductors of the largest and smallest nominal cross-sectional area given in table 3, as appropriate to their rating.

Portable socket-outlets are tested on a plain, horizontal surface in a position as in normal use, such that there is no strain on the flexible cable. They are fitted with flexible cables (see table 17) having conductors of the largest and smallest nominal cross-sectional area given in table 3, as appropriate to their rating.

Screws of the enclosure operated when mounting the accessory are tightened with a torque equal to two-thirds of the applicable torque given in table 6.

Glands are tightened with a torque equal to two-thirds of that applied during the test of 24.6.

NOTE 3 Glands are not filled with sealing compound or the like.

Parts which can be removed without the aid of a tool are removed.

If the enclosure of a socket-outlet that has an IP code less than IPX5 is designed with drain holes, one drain hole is opened, as for normal use, in the lowest position. If the enclosure of a socket-outlet that has an IP code equal to or greater than IPX5 is designed with drain holes, they shall not be opened.

Socket-outlets are tested without a plug in engagement and with the lid, if any, closed.

NOTE 4 In the following countries fixed socket-outlets are also tested with the plug in engagement: AT, AU, DK.

Plugs are tested when in full engagement first with a fixed and then with a portable socket-outlet of the same system and with the same degree of protection against harmful effects due to ingress of water, if defined in the system.

NOTE 5 In some systems plugs and socket-outlets may not have the same degree of protection.

Care shall be taken not to disturb, for example, to knock or shake, the assembly, in such a way that the test result will be affected.

If an accessory has drain holes which have been opened, it shall be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the complete assembly.

The specimens shall withstand an electric strength test specified in 17.2 which shall be started within 5 min of completion of the test according to this subclause.

16.3 Resistance to humidity

Accessories shall be proof against humidity which may occur in normal use.

Compliance is checked by the humidity treatment described in this subclause, followed immediately by the measurement of the insulation resistance and by the electric strength test specified in clause 17.

Inlet openings, if any, are left open; if knock-outs are provided, one of them is opened.

Parts which can be removed without the aid of a tool, are removed and subjected to the humidity treatment along with the main part; spring lids are open during this treatment.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %.

The temperature of the air in which the specimens are placed is maintained within ±1 K of any convenient value t between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the specimens are brought to a temperature between t and (t + 4) °C.

The specimens are kept in the cabinet for

- *two days (48 h) for accessories having an IP code of IPX0;*
- *seven days (168 h) for accessories having an IP code higher than IPX0.*

NOTE 1 In most cases, the specimens may be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment.

NOTE 2 A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2 SO_4) or potassium nitrate (KNO_3) in water, having a sufficiently large contact surface with the air.

NOTE 3 In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

After this treatment, the specimens shall show no damage within the meaning of this standard.

17 Insulation resistance and electric strength

The insulation resistance and electric strength of accessories shall be adequate.

Compliance is checked by the following tests, which are made immediately after the test of 16.3, in the humidity cabinet or in the room in which the specimens were brought to the prescribed temperature, after re-assembly of those parts which can be removed without the aid of a tool, which were removed for the test.

17.1 *The insulation resistance is measured with a d.c. voltage of approximately 500 V, the measurement being made 1 min after application of the voltage.*

The insulation resistance shall be not less than 5 M .

17.1.1 *For socket-outlets, the insulation resistance is measured consecutively:*

a) between all poles connected together and the body, the measurement being made with a plug in engagement;

b) between each pole in turn and all others, these being connected to the body with a plug in engagement;

c) between any metal enclosure and metal foil in contact with the inner surface of its insulating linings, if any;

NOTE 1 This test is only made if an insulating lining is necessary to provide insulation.

d) between any metal part of the cord anchorage, including clamping screws, and earthing terminal(s) or earthing contact(s), if any, of portable socket-outlets;

e) between any metal part of the cord anchorage of portable socket-outlets and a metal rod of the maximum diameter of the flexible cable inserted in its place (see table 17).

The term "body" used in a) and b) includes all accessible metal parts, metal frames supporting the base of flush-type socket-outlets, metal foil in contact with the outer surface of accessible external parts of insulating material, fixing screws of bases or covers and cover-plates, external assembly screws, earthing terminals or earthing contacts.

NOTE 2 Measurements c), d) and e) are not made on non-rewirable portable socket-outlets.

NOTE 3 While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of a straight unjointed test finger test probe 11 of IEC 61032.

17.1.2 *For plugs, the insulation resistance is measured consecutively*

a) between all poles connected together and the body;

b) between each pole in turn and all others, these being connected to the body;

c) between any metal part of the cord anchorage, including clamping screws, and earthing terminal(s) or earthing contact(s), if any;

d) between any metal part of the cord anchorage and a metal rod of the maximum diameter of the flexible cable inserted in its place (see table 17).

The term "body" used in a) and b) includes accessible metal parts, external assembly screws, earthing terminals, earthing contacts and a metal foil in contact with the outer surface of accessible external parts of insulating material, other than the engagement face.

NOTE 1 Measurements c) and d) are not made on non-rewirable plugs.

NOTE 2 While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of a straight unjointed test finger test probe 11 of IEC 61032.

17.2 *A voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz, is applied for 1 min between the parts indicated in 17.1.*

The test voltage shall be as follows:

– *1 250 V for accessories having a rated voltage up to and including 130 V;*
– *2 000 V for accessories having a rated voltage exceeding 130 V.*

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

NOTE 1 The high-voltage transformer used for the test should be so designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA.

NOTE 2 The overcurrent relay should not trip when the output current is less than 100 mA.

NOTE 3 Care is taken that the r.m.s. value of the test voltage applied is measured within ±3 %.

NOTE 4 Glow discharges without drop in the voltage are neglected.

18 Operation of earthing contacts

Earthing contacts shall provide adequate contact pressure and shall not deteriorate in normal use.

Compliance is checked by the tests of clauses 19 and 21.

19 Temperature rise

Accessories shall be so constructed that they comply with the following temperature-rise test.

Non-rewirable accessories are tested as delivered.

Rewirable accessories are fitted with polyvinyl chloride insulated conductors having a nominal cross-sectional area as shown in table 15.

Table 15 – Nominal cross-sectional areas of copper conductors for the temperature-rise test

Rated current A	**Nominal cross-sectional area** mm²	
	Flexible conductors for portable accessories	**Rigid conductors (solid or stranded) for fixed accessories**
Up to and including 10	1	1,5
Over 10 up to and including 16	1,5	2,5
Over 16	4	6

The terminal screws or nuts are tightened with a torque equal to two-thirds of that specified in 12.2.8.

NOTE 1 To ensure normal cooling of the terminals, the conductors connected to them should have a length of at least 1 m.

Flush-mounted accessories are mounted in flush-mounted boxes. The box is placed in a block of pinewood filled around the box with plaster, so that the front edge of the box does not protrude and is not more than 5 mm below the front surface of the pinewood block.

NOTE 2 The test assembly should be allowed to dry for at least seven days when first made.

The size of the pinewood block, which may be fabricated from more than one piece, shall be such that there is at least 25 mm of wood surrounding the plaster, the plaster having a thickness between 10 mm and 15 mm around the maximum dimensions of the sides and rear of the box.

NOTE 3 The sides of the cavity in the pinewood block may have a cylindrical shape.

The cable(s) connected to the socket-outlet shall enter through the top of the box, the point(s) of entry being sealed to prevent the circulation of air. The length of each conductor within the box shall be (80 ± 10) mm.

Surface-type socket-outlets shall be mounted centrally on the surface of a wooden block, which shall be at least 20 mm thick, 500 mm wide and 500 mm high.

Other types of socket-outlets shall be mounted according to the manufacturer's instruction or, in the absence of such an instruction, in the position of normal use considered to give the most onerous conditions.

The test assembly shall be placed in a draught-free environment for the test.

Socket-outlets are tested using a test plug with brass pins having the minimum specified dimensions.

Plugs are tested using a fixed socket-outlet complying with this standard and having as near-to-average characteristics as can be selected, but with minimum size of the earthing pin, if any.

The plug is inserted into the socket-outlet and an alternating current as specified in table 20, is passed for 1 h.

For accessories having three poles or more, the current during the test shall be passed through the phase contacts, where applicable. In addition, separate tests shall be made passing the current through the neutral contact, if any, and the adjacent phase contact and through the earthing contact, if any, and the nearest phase contact. For the purpose of this test, earthing contacts, irrespective of their number, are considered as one pole.

In the case of multiple socket-outlets, the test is carried out on one socket-outlet of each type and current rating.

The temperature is determined by means of melting particles, colour-changing indicators or thermocouples, chosen and positioned so that they have negligible effect on the temperature being determined.

The temperature rise of the terminals shall not exceed 45 K.

NOTE 4 For the purpose of the test of 25.3, the temperature rise of external parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, is also determined.

NOTE 5 In the case of accessories incorporating dimmers, fuses, switches, energy regulators, etc., these other elements are short-circuited for the purpose of this test.

20 Breaking capacity

Accessories shall have adequate breaking capacity.

Compliance is checked by testing socket-outlets and plugs with pins which are not solid, by means of an appropriate test apparatus, an example of which is shown in figure 16.

Rewirable accessories are fitted with conductors as specified for the test of clause 19.

NOTE 1 A revision of the test apparatus shown in figure 16 is under consideration.

NOTE 2 In case of failure of the shutters, the test on shuttered socket-outlets may be repeated with operations made by hand.

Socket-outlets are tested using a test plug with brass pins provided, if applicable, with insulating sleeves, and having the maximum specified dimensions, with a tolerance of $^{0}_{0,06}$ mm, and spaced at the nominal distance, with a tolerance of $^{+0,05}_{0}$ mm. As far as the extremities of the sleeves are concerned, it is sufficient that their dimensions are within the tolerances given in the relevant standard sheet.

NOTE 3 The shapes of the extremities of the insulating sleeves are not considered of importance for the purpose of the test, provided that they are according to the relevant standard sheet.

NOTE 4 The material of the brass pins of the test plug should be as specified in ISO 1639, Type CuZn39Pb2-M, and their micro-composition should be homogeneous.

The ends of round pins are rounded.

Plugs are tested using a fixed socket-outlet complying with this standard and having as near-to-average characteristics as can be selected.

NOTE 5 Care should be taken that the pins of the test plug are in good condition before the test is started.

For accessories with a rated voltage lower than or equal to 250 V and a rated current lower than or equal to 16 A, the length of the stroke of test apparatus is between 50 mm and 60 mm.

NOTE 6 The length of the stroke for accessories with other ratings is under consideration.

The plug is inserted and withdrawn from the socket-outlet 50 times (100 strokes) at a rate of

- *30 strokes per minute for accessories having a rated current up to and including 16 A and a rated voltage up to and including 250 V;*
- *15 strokes per minute for other accessories.*

NOTE 7 A stroke is an insertion or a withdrawal of the plug.

The test voltage shall be 1,1 times the rated voltage and the test current shall be 1,25 times the rated current.

The periods during which the test current is passed from the insertion of the plug until subsequent withdrawal are as follows:

- *for accessories with rated current 16 A: $1,5^{+0,5}_{0}$ s*
- *for accessories with rated current >16 A: $3^{+0,5}_{0}$ s*

Accessories are tested using an alternating current with cos = 0,6 ± 0,05.

No current is passed through the earthing circuit, if any.

The test is made with the connections shown in figure 17. Two-pole accessories with neutral contact (2P + N and 2P + N + ⏚ *) are connected to two phases and the neutral of a three-phase system.*

Resistors and inductors are not connected in parallel except, if an air-core inductor is used, a resistor taking approximately 1 % of the current through the inductor is connected in parallel with it.

Iron-cored inductors may be used, provided the current has a substantially sine-wave form.

For the test on three-pole accessories, three-core inductors are used.

Accessible metal parts, metal supports and any metal frame supporting the base of flush-type socket-outlets are connected through the selector switch C; for two-pole accessories, to one of the poles of the supply for half the number of strokes, and to the other pole for the remainder; for three-pole accessories, they are connected consecutively to each pole of the supply for one-third of the number of strokes.

In the case of multiple socket-outlets, the test is carried out on one socket-outlet of each type and current rating.

During the test, no sustained arcing shall occur.

After the test, the specimens shall show no damage impairing their further use and the entry holes for the pins shall not show any damage which may impair the safety within the meaning of this standard.

21 Normal operation

Accessories shall withstand without excessive wear or other harmful effect, the mechanical, electrical and thermal stresses occurring in normal use.

Compliance is checked by testing socket-outlets, and plugs with resilient earthing socket-contacts or with pins which are not solid, by means of an appropriate test apparatus, an example of which is shown in figure 16.

NOTE 1 A revision of the test apparatus shown in figure 16 is under consideration.

The test pins (during the socket-outlet test) and the fixed socket-outlets (during the plug test for plugs with resilient earthing socket-contacts or with pins which are not solid) shall be replaced after 4 500 and 9 000 strokes.

NOTE 2 In case of failure of the shutters, tests on shuttered socket-outlets may be repeated, performing the required number of strokes (i.e. 10 000 strokes) with current flowing on specimens prepared by the manufacturer without shutters, and by performing the same number of strokes without current flowing on specimens provided with shutters, or, as a third choice, with operations made by hand as in normal use.

Socket-outlets are tested using a test plug with brass pins provided, if applicable, with insulating sleeves, and having the maximum specified dimensions, with a tolerance of $^{0}_{0,06}$ *mm, and spaced at the nominal distance with a tolerance of* $^{+0,05}_{0}$ *mm. As far as the extremities of the sleeves are concerned, it is sufficient that their dimensions are within the tolerances given in the relevant standard sheet.*

NOTE 3 The shapes of the extremities of the insulating sleeves are not considered of importance for the purpose of the test, provided that they are according to the relevant standard sheet.

NOTE 4 The material of the brass pins of the test plug should be as specified in ISO 1639,Type CuZn39Pb2-M, and their micro-composition should be homogeneous.

The end of round pins are rounded.

Plugs are tested using a fixed socket-outlet complying with this standard and having as near to average characteristics as can be selected.

NOTE 5 Care should be taken that the pins of the test plug are in good condition before the test is started.

The specimens are tested with an alternating current as specified in table 20, at rated voltage, in a circuit with cos = 0,8 ± 0,05.

The plug is inserted and withdrawn from the socket-outlet 5 000 times (10 000 strokes) at a rate of

- *30 strokes per minute for accessories having a rated current up to and including 16 A and a rated voltage up to and including 250 V;*
- *15 strokes per minute for other accessories.*

NOTE 6 A stroke is an insertion or a withdrawal of the plug.

For accessories having a rated current lower than or equal to 16 A, the test current is passed during each insertion and withdrawal of the plug.

In all other cases, the test current is passed during alternate insertion and withdrawal, the other insertion and withdrawal being made without current flowing.

The periods during which the test current is passed from insertion of the plug until subsequent withdrawal are as follows:

- *for accessories having a rated current 16 A: $1,5^{+0,5}_{0}$ s*
- *for accessories having a rated current > 16 A: $3^{+0,5}_{0}$ s*

No current is passed through the earthing circuit, if any.

The test is made with the connections indicated in clause 20, the selector switch C being operated as prescribed in that clause.

In the case of multiple socket-outlets, the test is carried out on one socket-outlet of each type and current rating.

During the test, no sustained arcing shall occur.

After the test, the specimens shall not show

- *wear impairing their further use,*
- *deterioration of enclosures, insulating linings or barriers,*
- *damage to the entry holes for the pins, that might impair proper working,*
- *loosening of electrical or mechanical connections,*
- *seepage of sealing compound.*

For shuttered socket-outlets, a gauge according to figure 9 is applied to the entry holes corresponding to the live contacts with a force of 20 N.

The gauge is applied to the shutters in the most unfavourable position, successively in three directions to the same place, for approximately 5 s in each of the three directions.

During each application, the gauge shall not be rotated and it shall be applied such that the force of 20 N is maintained. When moving the gauge from one direction to the next, no force is applied but the gauge is not withdrawn.

A gauge according to figure 10 is then applied with a force of 1 N and in three directions, for approximately 5 s in each of the three directions, with independent movements, withdrawing the gauge after each movement.

It shall not be possible to touch live parts with the gauges of figures 9 and 10 when they remain under the relevant forces.

An electrical indicator, with a voltage between 40 V and 50 V, is used to show contact with the relevant part.

The specimens shall then comply with the requirements of clause 19, the test current being equal to the test current required for the normal operation test of this clause 21 and the temperature rise, at any point, not exceeding 45 K, and they shall withstand an electric strength test made according to 17.2, the test voltage being reduced to 1 500 V for accessories having a rated voltage of 250 V and to 1 000 V for accessories having a rated voltage of 130 V.

NOTE 7 The humidity treatment, according to 16.3, is not repeated before the electric strength test of this clause.

The tests of 13.2 and 14.2 are made after the tests of this clause.

22 Force necessary to withdraw the plug

The construction of accessories shall allow for easy insertion and withdrawal of the plug, and prevent the plug from working out of the socket-outlet in normal use.

For the purpose of this test, earthing contacts, irrespective of the number, are considered as one pole.

Interlocked accessories are tested in the unlocked position.

Compliance is checked, for socket-outlets only, by

- *a test to ascertain that the maximum force necessary to withdraw the test plug from the socket-outlet is not higher than the force specified in table 16, and*
- *a test to ascertain that the minimum force necessary to withdraw a single pin gauge from the individual contact assembly is not lower than the force specified in table 16.*

22.1 Verification of the maximum withdrawal force

The socket-outlet is fixed to the mounting plate A of an apparatus as shown in figure 18, so that the axis of the socket-contacts are vertical and the entry holes for the pins of the plug face downwards.

The test plugs have finely ground pins of hardened steel, having a surface roughness not exceeding 0,8 ∝m ($\sqrt{}^{0,8}$) over their active length and spaced at the nominal distance, with a tolerance of ± 0,05 mm.

The diameter for round pins and the distance between contact surfaces for other types of pins shall have, respectively, the maximum specified dimensions and the maximum length, with a tolerance of $^{0}_{0,01}$ mm.

NOTE 1 The maximum specified dimension is the nominal dimension plus the maximum tolerance.

The pins are wiped free from grease before each test using a suitable cold chemical degreasing agent.

NOTE 2 When degreasing operations are performed, adequate precautions should be taken to prevent inhalation of vapour.

The test plug with the maximum size pins is inserted and withdrawn from the socket-outlet ten times. It is then inserted again, a carrier E for a principal mass F and a supplementary mass G being attached to it by means of a suitable clamp D. The supplementary mass is such that it exerts a force equal to one-tenth of the maximum withdrawal force shown in table 16.

The principal mass, together with the supplementary mass, the clamp, the carrier and the plug exert a force equal to the maximum withdrawal force shown.

The principal mass is hung on the plug without jolting and the supplementary mass is, if necessary, allowed to fall from a height of 50 mm onto the principal mass.

The plug shall not remain in the socket-outlet.

22.2 Verification of the minimum withdrawal force

The test pin gauge, illustrated in figure 19, is applied to each individual contact with the socket-outlet held horizontally and the gauge hanging downwards.

Shutters if any, are rendered inoperative so as not to affect the test.

The test pin gauge is made of hardened steel, having a surface roughness not exceeding 0,8 ∝m ($\overset{0,8}{\nabla}$) over its active length.

The plug pin portion of the gauge shall have cross-sectional dimensions equal to the minimum shown in the appropriate standard sheet $^{0}_{0,01}$ mm and a length sufficient to make adequate contact with the socket-outlet. The force exerted by the gauge shall be equal to that specified in table 16.

NOTE 1 If the socket-outlet accepts plugs having pins with different dimensions, the smallest appropriate one should be used.

The pin is wiped free from grease before each test using a suitable cold chemical degreasing agent.

NOTE 2 When degreasing operations are performed, adequate precautions should be taken to prevent inhalation of vapour.

The test pin gauge is inserted into the contact assembly.

The test pin gauge is applied gently, and care is taken not to knock the assembly when checking the minimum withdrawal force.

The gauge shall not fall from the contact assembly within 30 s.

Table 16 – Maximum and minimum withdrawal forces

Ratings	Number of poles	Withdrawal forces N	
		Multi-pin gauge Maximum	Single-pin gauge Minimum
Up to and including 10 A	2	40	1,5
	3	50	
Above 10 A up to and including 16 A	2	50	2
	3	54	
	More than 3	70	
Above 16 A up to and including 32 A	2	80	3
	3	80	
	More than 3	100	

23 Flexible cables and their connection

23.1 Plugs and portable socket-outlets shall be provided with a cord anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals or terminations, their covering being protected from abrasion.

The sheath, if any, of the flexible cable shall be clamped within the cord anchorage.

Compliance is checked by inspection.

23.2 *The effectiveness of the retention of the cable by the cord anchorage is checked by the following test by means of an apparatus as shown in figure 20.*

Non-rewirable accessories are tested as delivered; the test is made on new specimens.

Rewirable accessories are first tested with a cable having the smallest nominal cross-sectional area, and then with a cable having the largest nominal cross-sectional area, as shown in table 17.

Accessories designed exclusively for use with flat flexible cables are tested only with the types of flat flexible cables specified.

Table 17 – External dimensions of flexible cables to be accommodated by cord anchorages

Rating of accessory	Number of poles [b]	Types of flexible cable (cable references)	Number of conductors and nominal cross-sectional area mm²	Limits for external dimensions for flexible cables mm	
				Minimum	Maximum
6 A up to and including 10 A. Up to and including 250 V[a]	2	60227 IEC 42 60227 IEC 53	2 0,75 2 0,75	2,7 5,4 3,8 6,0	3,2 6,4 5,2 7,6
6 A up to and including 10 A. Up to and including 250 V	2	60227 IEC 42 60227 IEC 53	2 0,75 2 1	2,7 5,4 6,4	3,2 6,4 8,0
	3	60227 IEC 53 60227 IEC 53	3 0,75 3 1	6,4	8,4
Above 10 A up to and including 16 A. Up to and including 250 V	2	60227 IEC 42 60227 IEC 53	2 0,75 2 1,5	2,7 5,4 7,4	3,2 6,4 9,0
	3	60227 IEC 53 60227 IEC 53	3 0,75 3 1,5	6,4	9,8
16 A Above 250 V	3	60227 IEC 53 60227 IEC 53	3 1 3 2,5	6,8	12,0
	4	60227 IEC 53 60227 IEC 53	4 1 4 2,5	7,6	13,0
	5	60227 IEC 53 60227 IEC 53	5 1 5 2,5	8,3	14,0
Above 16 A Up to and including 440 V	2	60227 IEC 53 60245 IEC 66	2 2,5 2 6	8,9 13,5	11,0 18,5
	3	60227 IEC 53 60245 IEC 66	3 2,5 3 6	9,6 14,5	12,0 20,0
	4	60227 IEC 53 60245 IEC 66	4 2,5 4 6	10,5 16,5	13,0 22,0
	5	60227 IEC 53 60245 IEC 66	5 2,5 5 6	11,5 18,0	14,0 24,5

[a] Exclusively designed for two-conductor flat flexible cables.

[b] Earthing contacts, irrespective of their number, are considered as one pole.

Conductors or flexible cables of rewirable accessories are introduced into the terminals, the terminal screws being tightened just sufficiently to prevent the position of the conductors from easily changing.

The cord anchorage is used in the normal way, clamping screws, if any, being tightened with a torque equal to two-thirds of that specified in table 6.

After reassembly of the specimen, the component parts shall fit snugly and it shall not be possible to push the flexible cable into the specimen to any appreciable extent.

The specimen is placed in the test apparatus so that the axis of the flexible cable is vertical where it enters the specimen.

The flexible cable is then subjected 100 times to a pull of

- *50 N if the rated current is 2,5 A,*
- *60 N if the rated current is above 2,5 A, but not more than 16 A and the rated voltage is up to and including 250 V,*
- *80 N if the rated current is above 2,5 A, but not more than 16 A and the rated voltage is above 250 V,*
- *100 N if the rated current greater than 16 A.*

The pulls are applied practically without jerks each time for 1 s.

Care shall be taken to exert the same pull on all parts (core, insulation and sheath) of the flexible cable simultaneously.

Immediately afterwards, the flexible cable is subjected for 1 min to a torque as specified in table 18.

Table 18 – Torque test values for cord anchorages

Rating of plug or portable socket-outlet	Flexible cable (number of cores nominal cross-sectional area in mm²)				
	2 0,5	2 0,75	3 0,5	3 0,75	(2 or more) 1
Up to and including 16 A and 250 V	0,10 Nm	0,15 Nm	0,15 Nm	0,25 Nm	0,25 Nm
16 A and above 250 V	–	–	–	–	0,35 Nm
Above 16 A	–	–	–	–	0,425 Nm

Plugs provided with flat tinsel cords are not subjected to the torque test.

After the tests, the flexible cable shall not have been displaced by more than 2 mm. For rewirable accessories, the end of the conductors shall not have moved noticeably in the terminals; for non-rewirable accessories, there shall be no break in the electrical connections.

For measurements of the longitudinal displacement, a mark is made on the flexible cable at a distance of approximately 20 mm from the end of the specimen or the flexible cable guard, before it is subjected to the pull.

If, for non-rewirable accessories, there is no definitive end to the specimen or the flexible cable guard, an additional mark is made on the body of the specimen.

The displacement of the mark on the flexible cable in relation to the specimen or flexible cable guard is measured while the flexible cable is subjected to the pull.

In addition, for rewirable accessories having a rated current up to and including 16 A, it shall be checked by a manual test that they are suitable for fitting with the appropriate cable, as shown in table 19.

Table 19 – Maximum dimensions of flexible cables to be accommodated in rewirable accessories

Rating of accessory	Number of poles [b]	Types of flexible cable (cable references)	Number of conductors and nominal cross-sectional area mm²	Maximum dimensions for flexible cables mm
6 A up to and including 10 A. Up to and including 250 V [a]	2	60245 IEC 51	2 0,75	8,0
6 A up to and including 10 A Up to and including 250 V	2	60245 IEC 53	2 1	8,8
	3	60245 IEC 53	3 1	9,2
Above 10 A up to and including 16 A Up to and including 250 V	2	60245 IEC 53	2 1,5	10,5
	3	60245 IEC 53	3 1,5	11,0
16 A Above 250 V	3	60245 IEC 53	3 2,5	13,0
	4	60245 IEC 53	4 2,5	14,0
	5	60245 IEC 53	5 2,5	15,5

[a] Exclusively designed for two-conductor flexible cables.

[b] Earthing contacts, irrespective of their number, are considered as one pole.

23.3 Non-rewirable plugs and non-rewirable portable socket-outlets shall be provided with a flexible cable complying with IEC 60227 or IEC 60245. The nominal cross-sectional areas of the conductors in relation to the rating of accessories are given in the relevant columns of table 20.

NOTE Table 20 also specifies the test currents for the test of temperature rise and normal operation.

Table 20 – Relationship between rating of accessories, nominal cross-sectional areas of test conductors and test currents for the tests of temperature rise (clause 19) and normal operation (clause 21)

Rating of accessory	Rewirable fixed accessories		Rewirable portable accessories		Non-rewirable portable socket-outlets			Non-rewirable plugs		
	Test current A		Test current A		Nominal cross-sectional area mm²	Test current A		Nominal cross-sectional area mm²	Test current A	
	Clause 19	Clause 21	Clause 19	Clause 21		Clause 19	Clause 21		Clause 19	Clause 21
2,5 A 130/250 V	–	–	–	–	–	–	–	Tinsel 0,5 0,75 1	1 2,5 4 4	1 2,5 2,5 2,5
6 A 130/250 V	9	6	8,4	6	–	–	–	Tinsel 0,5 0,75 1	1 2,5 9 9	1 2,5 6 6
10 A 130/250 V	16	10	14	10	0,75 1 1,5	10 12 16	10 10 10	0,5 0,75 1	2,5 10 12	2,5 10 10
16 A 130/250 V	22	16	20	16	1 1,5	12 16	12 16	Tinsel 0,5 0,75 1 1,5	1 2,5 10 12 16	1 2,5 10 12 16
16 A 440 V	22	16	20	16	1,5	16	16	1,5 2,5	16 22	16 22
32 A 130/250/440 V	40	32	40	32	2,5	25	25	2,5 4 6	25 31 42	25 31 32

NOTE 1 Tinsel cords and flexible cables having a nominal cross-sectional area of 0,5 mm², are allowed in lengths up to 2 m only.

NOTE 2 Plugs and connectors incorporated in cord sets are tested as specified in the respective relevant standard (this standard for plugs and the IEC 60320 series for connectors) each accessory being tested independently.

NOTE 3 The test currents for accessories having other rated currents are determined by interpolation between the next lower and the next higher standard ratings except that for clause 19 test currents for rewirable portable accessories, which are obtained as follows:

– for I_n 10 A test current = 1,4 I_n;

– for I_n >10 A test current = 1,25 I_n.

Flexible cables shall have the same number of conductors as there are poles in the plug or socket-outlet, earthing contacts, if any, being considered as one pole, irrespective of their number. The conductor connected to the earthing contact shall be identified by the colour combination green/yellow.

Compliance is checked by inspection, by measurement and by checking that the flexible cables are in accordance with the relevant parts of either IEC 60227 or IEC 60245, as applicable.

23.4 Non-rewirable plugs and non-rewirable portable socket-outlets shall be designed in such a way that the flexible cable is protected against excessive bending where it enters the accessory.

Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.

NOTE 1 Helical metal springs, whether bare or covered with insulating material, should not be used as flexible cable guards.

Compliance is checked by inspection and by a flexing test made by means of an apparatus as shown in figure 21.

The test is made on new specimens.

The specimen is fixed to the oscillating member of the apparatus so that, when it is at the middle of its travel, the axis of the flexible cable, where it enters the specimen, is vertical and passes through the axis of oscillation.

Specimens with flat cords are mounted so that the major axis of the section is parallel to the axis of oscillation.

The accessory shall be fixed in the test apparatus in the following way:

- *plugs: by the pins;*
- *portable socket-outlets: at a distance of 4 mm to 5 mm in the direction of the flexible cable, from the engagement face; a test plug having the maximum dimensions shall be inserted in the portable socket-outlet during the test.*

The accessory is, by variation of the distance between the fixing part of the oscillating member and the axis of oscillation, positioned so that the flexible cable makes the minimum lateral movement when the oscillating member of the test apparatus is moved over its full travel.

NOTE 2 In order to have the possibility of easily finding by experiment the mounting position with a minimum lateral movement of the flexible cable during the test, the flexing apparatus should be built in such a way that the different supports for the accessories mounted on the oscillating member can be readily adjusted.

NOTE 3 It is recommended to have a device (for example, a slot or a pin) to see whether the flexible cable makes the minimum lateral movement.

The flexible cable is loaded with a mass such that the force applied is

- *20 N for accessories with flexible cables having a nominal cross-sectional area exceeding 0,75 mm^2;*
- *10 N for other accessories.*

A current equal to the rated current of the accessory or the following current, whichever is the lower, is passed through the conductors:

- *16 A for accessories with flexible cables having a nominal cross-sectional area larger than 0,75 mm^2;*
- *10 A for accessories with flexible cables having a nominal cross-sectional area of 0,75 mm^2;*
- *2,5 A for accessories with flexible cables having a nominal cross-sectional area less than 0,75 mm^2.*

The voltage between the conductors is equal to the rated voltage of the specimen.

The oscillating member is moved through an angle of 90° (45° on either side of the vertical), the number of flexings being 10 000 and the rate of flexing 60/min.

NOTE 4 A flexing is one movement, either backwards or forwards.

Specimens with circular section flexible cables are turned through 90° in the oscillating member after 5 000 flexings; specimens with flat flexible cables are only bent in a direction perpendicular to the plane containing the axes of the conductors.

During the flexing test, there shall be

– *no interruption of the current,*
– *no short circuit between conductors.*

NOTE 5 A short-circuit between the conductors of the flexible cable is considered to occur if the current attains a value equal to twice the test current of the accessory.

The voltage drop between each contact and the corresponding conductor, with a test current flowing having a value as prescribed for clause 21, shall not exceed 10 mV.

After the test, the guard, if any, shall not have separated from the body and the insulation of the flexible cable shall show no sign of abrasion or wear; broken strands of the conductors shall not have pierced the insulation so far as to become accessible.

24 Mechanical strength

Accessories, surface mounting boxes and screwed glands shall have adequate mechanical strength so as to withstand the stresses imposed during installation and use.

Compliance is checked by the appropriate tests of 24.1 to 24.13 as follows:

– *for all kinds of fixed socket-outlets* *24.1;*
– *for fixed socket-outlets with a base intended to be mounted directly on a surface* *24.3;*
– *for portable single socket-outlets:*
  - *with enclosures, covers or bodies other than of elastomeric or thermoplastic material* *24.2;*
  - *with enclosures, covers or bodies of elastomeric or thermoplastic material* *24.2, 24.4 and 24.5;*
– *for portable multiple socket-outlets:*
  - *with enclosures, covers or bodies other than of elastomeric or thermoplastic material* *24.1 and 24.9;*
  - *with enclosures, covers or bodies of elastomeric or thermoplastic material* *24.1, 24.4 and 24.9;*
– *for plugs:*
  - *with enclosures, covers or bodies other than of elastomeric or thermoplastic material* *24.2 and 24.10;*
  - *with enclosures, covers or bodies of elastomeric or thermoplastic material* *24.2, 24.4, 24.5 and 24.10;*
– *for screwed glands of accessories having an IP code higher than IP20* *24.6;*
– *for plug pins provided with insulating sleeves* *24.7;*
– *for shuttered socket-outlets* *24.8;*
– *for surface-type mounting boxes* *24.1;*
– *for portable socket-outlets having means for suspension* *24.11, 24.12 and 24.13.*

24.1 *The specimens are subjected to blows by means of an impact-test apparatus as shown in figures 22, 23, 24 and 25.*

The striking element has a hemispherical face of 10 mm radius, made of polyamide having a Rockwell hardness of HR 100, and a mass of (150 ± 1) g.

It is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and a wall thickness of 0,5 mm, which is pivoted at its upper end in such a way that it swings only in a vertical plane.

The axis of the pivot is (1 000 ± 1) mm above the axis of the striking element.

The Rockwell hardness of the polyamide striking element is determined by using a ball having a diameter of (12,700 ± 0,0025) mm, the initial load being (100 ± 2) N and the extra load (500 ± 2,5) N.

NOTE 1 Additional information concerning the determination of the Rockwell hardness of plastics is given in ISO 2039-2.

The design of the apparatus is such that a force between 1,9 N and 2,0 N has to be applied to the face of the striking element to maintain the tube in a horizontal position.

The specimens are mounted on a sheet of plywood, 8 mm nominal thickness and approximately 175 mm square, secured at its top and bottom edges to a rigid bracket which is part of the mounting support.

The mounting support shall have a mass of (10 ± 1) kg and shall be mounted on a rigid frame by means of pivots. The frame is fixed to a solid wall.

The design of the mounting is such that

- *the specimen can be placed in such a way that the point of impact lies in the vertical plane through the axis of the pivot,*
- *the specimen can be moved horizontally and turned about an axis perpendicular to the surface of the plywood,*
- *the plywood can be turned 60°, in both directions about a vertical axis.*

Surface type socket-outlets and surface-mounting boxes are mounted on the plywood as in normal use.

Inlet openings which are not provided with knock-outs, are left open; if they are provided with knock-outs, one of them is opened.

Flush-type socket-outlets are mounted in a recess provided in a block of hornbeam or material having similar mechanical characteristics, which is fixed to a sheet of plywood, and not in its relevant mounting box.

If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of impact.

Flush-type screw fixing socket-outlets shall be fixed by means of screws to lugs recessed in the hornbeam block. Flush-type claw fixing socket-outlets shall be fixed to the block by means of the claws.

Before applying the blows, fixing screws of bases and covers are tightened with a torque equal to two-thirds of that specified in table 6.

The specimens are mounted so that the point of impact lies in a vertical plane through the axis of the pivot.

The striking element is allowed to fall from a height specified in table 21.

Table 21 – Height of fall for impact tests

Height of fall mm	Parts of enclosures subjected to impact	
	Accessories having IP code IPX0	Accessories having an IP code higher than IPX0
100	A and B	–
150	C	A and B
200	D	C
250	–	D

A: Parts on the front surface, including the parts which are recessed.

B: Parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of parts specified in A.

C: Parts other than those specified in A which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use.

D: Parts other than those specified in A which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use.

The impact energy determined by the part of the specimen which projects most from the mounting surface is applied on all parts of the specimen, with the exception of those specified in A.

The height of fall is the vertical distance between the position of a checking point, when the pendulum is released, and the position of that point at the moment of impact. The checking point is marked on the surface of the striking element where the line through the point of intersection of the axes of the steel tube of the pendulum and the striking element, perpendicular to the plane through both axes, meets the surface.

The specimens are subjected to blows, which are evenly distributed. The blows are not applied to knock-outs.

The following blows are applied:

- *for parts specified in A, five blows (see figure 26a and figure 26b):*
  - ∞ *one blow to the centre,*
  - ∞ *one blow on each of the two most unfavourable points between the centre and the edges, after the specimen has been moved horizontally,*
  - ∞ *one blow on similar points, after the specimen has been turned 90° about its axis perpendicular to the plywood;*
- *for parts specified in B (as far as applicable), C and D, four blows:*
  - ∞ *one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis (see figure 26c);*
  - ∞ *one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis, in the opposite direction (see figure 26c).*

After the specimen has been turned 90° about its axis perpendicular to the plywood sheet:

- *one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis (see figure 26d);*
- *one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis in the opposite direction (see figure 26d).*

If inlet openings are provided, the specimen is mounted in such a way that the two lines of blows are, as closely as possible, equidistant from these openings.

Cover-plates and other covers of multiple socket-outlets are treated as though they were the corresponding number of separate covers, but only one blow is applied to any one point.

For socket-outlets having an IP code higher than IPX0, the test is made with the lids, if any, closed and, in addition the appropriate number of blows is applied to those parts which are exposed when the lids are open.

After the test, the specimen shall show no damage within the meaning of this standard. In particular, live parts shall not become accessible.

After the test on a lens (window for pilot lights) the lens may be cracked and/or dislodged, but it shall not be possible to touch live parts with

- *the test probe B of IEC 61032 under the conditions stated in 10.1;*
- *the test probe 11 of IEC 61032 under the conditions stated in 10.1, but with a force of 10 N;*
- *the steel wire of figure 10, applied with a force of 1 N, for accessories with increased protection.*

In case of doubt, it is verified that it is possible to remove and replace external parts such as boxes, enclosures, covers and cover-plates, without these parts or their insulating lining being broken.

If a cover-plate backed by an inner cover is broken, the test is repeated on the inner cover, which shall remain unbroken.

NOTE 2 Damage to the finish, small dents which do not reduce creepage distances or clearances below the value specified in 27.1 and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are neglected.

Cracks not visible with normal or corrected vision, without additional magnification, and surface cracks in fibre-reinforced mouldings and the like are ignored.

Cracks or holes in the outer surface of any part of the accessory are ignored if the accessory complies with this standard even if this part is omitted. If a decorative cover is backed by an inner cover, fracture of the decorative cover is ignored if the inner cover withstands the test after removal of the decorative cover.

24.2 *Rewirable portable accessories are fitted with the flexible cable specified in 23.2 having the smallest nominal cross-sectional area specified in table 3 and a free length of approximately 100 mm measured from the outer end of the guard.*

Terminal screws and assembly screws are tightened with a torque equal to two-thirds of that specified in table 6.

Non-rewirable accessories are tested as delivered, the flexible cable being cut so that a free length of about 100 mm projects from the accessory.

The specimens are individually subjected to the test Ed: Free fall, procedure 2 of IEC 60068-2-32, the number of falls being

- *1 000 if the mass of the specimen without flexible cable does not exceed 100 g,*
- *500 if the mass of the specimen without flexible cable exceeds 100 g, but does not exceed 200 g, and*
- *100 if the mass of the specimen without flexible cable exceeds 200 g.*

The barrel is turned at a rate of five revolutions per minute, 10 falls per minute thus taking place.

After the test, the specimens shall show no damage within the meaning of this standard. In particular,

- *no part shall have become detached or loosened;*
- *the pins shall not have become so deformed that the plug cannot be introduced into a socket-outlet complying with the relevant standard sheet and also fails to comply with the requirements of 9.1 and 10.3;*
- *the pins shall not turn when a torque of 0,4 Nm is applied, first in one direction for 1 min and then in the opposite direction for 1 min.*

NOTE 1 During the examination after the test, special attention is paid to the connection of the flexible cable.

NOTE 2 Small pieces may be broken off without causing rejection provided that the protection against electric shock is not affected.

NOTE 3 Damage to the finish and small dents which do not reduce the creepage distances or clearances below the values specified in 27.1 are ignored.

24.3 *The bases of surface type socket-outlets are first fixed to a cylinder of rigid steel sheet, having a radius equal to 4,5 times the distance between fixing holes but, in any case, no less then 200 mm. The axes of the holes are in a plane perpendicular to the axis of the cylinder and parallel to the radius through the centre of the distance between the holes.*

The fixing screws of the base are gradually tightened, the maximum torque applied being 0,5 Nm for screws having a thread diameter up to and including 3 mm and 1,2 Nm for screws having a larger thread diameter.

The bases of socket-outlets are then fixed in a similar manner to a flat steel sheet.

During and after the tests, the bases of socket-outlets shall show no damage impairing their further use.

24.4 *The specimens are subjected to an impact test by means of an apparatus as shown in figure 27.*

The apparatus, positioned on a pad of sponge rubber 40 mm thick, is placed together with the specimens in a freezer at a temperature of (–15 ± 2) °C, for at least 16 h.

At the end of this period, each specimen, in turn, is placed in the normal position of use as shown in figure 27, and a weight is allowed to fall from a height of 100 mm. The mass of the falling weight is (1 000 ± 2) g.

After the test, the specimen shall show no damage within the meaning of this standard.

24.5 *The specimens are subjected to a compression test as shown in figure 8, the temperature of the pressure plate, of the base and of the specimens being (23 ± 2) °C and the force applied being 300 N.*

The specimens are first placed in position a), as shown in figure 8, and the force is applied for 1 min. They are then placed in position b), as shown in figure 8, and again subjected to the force for 1 min.

The specimens are removed from the test apparatus and after 15 min they shall show no damage within the meaning of this standard.

24.6 *Screwed glands are fitted with a cylindrical metal rod having a diameter, in millimetres, equal to the nearest whole number below the internal diameter, in millimetres, of the packing.*

The glands are then tightened by means of a suitable spanner, the torque shown in table 22 being applied for 1 min.

Table 22 – Torque test values for glands

Diameter of test rod mm	**Torque** Nm	
	Metal glands	**Glands of moulded material**
Up to and including 14	6,25	3,75
Above 14, up to and including 20	7,5	5,0
Above 20	10,0	7,5

After the test, the glands and the enclosures of the specimens shall show no damage within the meaning of this standard.

24.7 *Plug pins provided with insulating sleeves are subjected to the following test by means of an apparatus as shown in figure 28.*

The test apparatus comprises a horizontally disposed beam, which is pivoted about its centre point. A short length of steel wire, 1 mm in diameter and bent into a U-shape, the base of the U being straight, is rigidly attached, at both ends, to one end of the beam, so that the straight part projects below the beam and is parallel to the axis of the beam pivot.

The plug is held by a suitable clamp in such a position that the straight part of the steel wire rests on the plug pin, perpendicular to it. The pin slopes downwards at an angle of 10° to the horizontal.

The beam is loaded so that the wire exerts a force of 4 N on the pin.

The plug is moved backwards and forwards in a horizontal direction in the plane of the axis of the beam, so that the wire rubs along the pin. The length of the pin thus abraded is approximately 9 mm, of which approximately 7 mm is over the insulating sleeve. The number of movements is 20 000 (10 000 in each direction) and the rate of operation is 30 movements per minute.

The test is made on one pin of each specimen.

After the test, the pins shall show no damage which may affect safety or impair the further use of the plug, in particular, the insulating sleeve shall not have punctured or rucked up.

24.8 Shuttered socket-outlets shall have the shutter so designed that it withstands the mechanical force which may be expected in normal use, for example when a pin of a plug is inadvertently forced against the shutter of a socket-outlet entry hole.

Compliance is checked by the following tests, which are carried out on specimens which have been submitted to the test according to clause 21, both with and without previous treatment as in 16.1.

One pin from a plug of the same system is applied for 1 min with a force of 40 N against the shutter of an entry hole in a direction perpendicular to the front surface of the socket-outlet.

For shutters provided as the only means to prevent single pole insertion, the force shall be 75 N instead of 40 N.

Where the socket-outlet is designed to accept plugs of different types, the test is made with a pin from a plug with the largest size pin.

The pin shall not come in contact with live parts.

An electrical indicator with a voltage not less than 40 V and not more than 50 V is used to show contact with the relevant part.

After the test, the specimens shall show no damage within the meaning of this standard.

NOTE Small dents on the surface which do not adversely affect further use of the socket-outlet are ignored.

24.9 *Rewirable multiple portable socket-outlets are fitted with the lightest type of flexible cable of the smallest nominal cross-sectional area specified in table 3.*

The free end of the flexible cable is fixed to a wall at a height of 750 mm above the floor, as shown in figure 29.

The specimen is held so that the flexible cable is horizontal and then it is allowed to fall onto a concrete floor, eight times, the flexible cable being rotated through 45° at its fixing after each fall.

After the test, the specimens shall show no damage within the meaning of this standard; in particular, no part shall have become detached or loosened.

Accessories having an IP code higher than IPX0 shall be submitted again to the relevant test as specified in 16.2.

NOTE Small chips and dents which do not adversely affect the protection against electric shock or harmful effects due to ingress of water are ignored.

24.10 *This test is made on new specimens.*

The plug is placed on a rigid steel plate provided with holes suitable for the pins of the plug as shown as an example in figure 30.

The distances between the centres of the holes (for example, d_1 and d_2) shall be the same as the distances between the centres of the circle circumscribed around the cross-sectional area of each pin in the standard sheet of the plug.

Each hole shall have a diameter equal to that of the circle circumscribed around the cross-sectional area of the pin plus (6 ± 0,5) mm.

The plug is positioned on the steel plate in such a way that the centres of the circles circumscribing the pins coincide with the centres of the holes.

A pull P equal to the maximum withdrawal force as given in table 16, is applied, without jerks, for 1 min on each pin in turn, in the direction of the longitudinal axis of the pin.

The pull is applied within a heating cabinet at a temperature of (70 ± 2) °C, 1 h after the plug has been placed in the heating cabinet.

After the test, the plug is allowed to cool down to ambient temperature and it shall be verified that no pin has been displaced in the body of the plug by more than 1 mm.

24.11 *Barriers, between the space intended for the suspension means fixed to the mounting surface and the live parts, likely to be subjected to mechanical strain when the portable socket-outlet is suspended on a mounting surface, are tested as follows.*

A cylindrical steel rod, having a diameter of 3 mm and a hemispherical end with a radius of 1,5 mm, is pushed perpendicular to the supporting mounting surface, in the most unfavourable position, for 10 s against the barrier, the force being equal to 1,5 times the maximum plug withdrawal force (as specified in 22.2, table 16).

The rod shall not pierce the barrier.

24.12 *The portable socket-outlet, fitted with an appropriate flexible cable, is suspended on the mounting surface as in normal use, by means of a cylindrical steel rod having the same dimensions as the rod described in 24.11, and a length sufficient to touch the rear of the barrier.*

A pull equal to the force prescribed in 23.2 for checking the flexible cable anchorage is applied, in the most unfavourable position, to the flexible cable for 10 s.

During the test, the portable socket-outlet means for suspension on a mounting surface shall not break in a way which allows live parts to become accessible to the standard test finger.

24.13 *The portable socket-outlet is suspended on the mounting surface as in normal use, using a round head screw with shank diameter of 3 mm, and is subjected to a pull test with the maximum withdrawal force specified, for the corresponding plug, in table 16, applied without jerks.*

The pull force is applied for 10 s perpendicular to the engagement face of the socket-outlet giving the greatest strain on the suspension means.

During the test, the portable socket-outlet means for suspension on a wall shall not break in a way which allows live parts to become accessible to the test probe B of IEC 61032.

NOTE Where more than one means of suspension exist, the tests of 24.11, 24.12 and 24.13 are carried out on each means of suspension.

24.14 *When checking the forces necessary to retain or remove covers, cover-plates or parts of them, the accessories are mounted as for normal use.*

Flush-type socket-outlets are fixed in appropriate mounting boxes, which are installed as for normal use so that the rims of the boxes are flush with the walls and covers or cover-plates, or parts of them, are fitted.

Plugs and portable socket-outlets are fixed in a suitable manner so that the force can be applied to the cover, cover-plates or parts of them.

If the covers or cover-plates, or parts of them, are provided with locking means which can be operated without the aid of a tool, these means are unlocked.

For fixed socket-outlets, compliance is checked according to 24.14.1 and 24.14.2 (see 13.7.2).

For plugs and portable socket-outlets compliance is checked according to 24.14.3.

24.14.1 Verification of the retention of covers or cover-plates

Forces are gradually applied perpendicular to the mounting surface, in such a way that the resulting force acting on the centre of the covers, cover-plates, or parts of them is respectively

– *40 N, for covers, cover-plates or parts of them complying with the tests of 24.17 and 24.18, or*
– *80 N, for other covers, cover-plates or parts of them.*

The force is applied for 1 min. The covers or cover-plates shall not come off.

The test is then repeated on new specimens, the cover or cover-plate being fitted on the wall after a sheet of hard material, (1 ± 0,1) mm thick, has been fitted around the supporting frame as shown in figure 31.

NOTE The sheet of hard material is used to simulate wallpaper and may consist of a number of pieces.

After the test, the specimens shall show no damage within the meaning of this standard.

24.14.2 Verification of the removal of covers or cover-plates

A force not exceeding 120 N is gradually applied, perpendicular to the mounting/supporting surfaces, to covers, cover-plates or parts of them by means of a hook placed in turn in each of the grooves, holes, spaces or the like, provided for removing them.

The covers or cover-plates shall come off.

The test is made 10 times on each separable part, the fixing of which is not dependent on screws, the removal force being applied each time to the different grooves, holes, or the like provided for removing the separable part, equally distributing as far as practicable the application points.

The test is then repeated on new specimens, the cover or cover-plate being fitted on the wall after a sheet of hard material, (1 ± 0,1) mm thick, has been fitted around the supporting frame, as shown in figure 31.

After the test, the specimens shall show no damage within the meaning of this standard.

24.14.3 *For plugs and portable socket-outlets, a force is gradually applied until 80 N is achieved and maintained for 1 min, to covers, cover-plates or parts of them while the other parts of the accessory are fixed.*

The test shall be carried out in the most unfavourable conditions.

During the test the covers, cover-plates or parts of them shall not come off.

The test is then repeated with a force of 120 N.

a) *For rewirable plugs and rewirable portable socket-outlets the cover, the cover-plate or parts of them may come off during the test but the specimen shall show no damage within the meaning of this standard.*

b) *For non-rewirable, non moulded-on accessories, during the test, the cover, the cover-plate or parts of them may come off but the accessories shall be permanently useless (see 14.1).*

24.15 *The test is made as described in 24.14, but applying, for 24.14.1, the following forces:*

– *10 N, for covers or cover-plates complying with the tests of 24.17 and 24.18;*

– *20 N, for other covers or cover-plates.*

24.16 *The test is made as described in 24.14, but applying, for 24.14.1, the force of 10 N for all covers or cover-plates.*

24.17 *The gauge shown in figure 32 is pushed toward each side of each cover or cover-plate which is fixed without screws on a mounting or supporting surface, as shown in figure 33. The face B resting on the mounting/supporting surface, with the face A perpendicular to it, the gauge is applied at right angles to each side under test.*

In the case of a cover or cover-plate fixed without screws to another cover or cover-plate, or to a mounting box having the same outline dimensions, face B of the gauge shall be placed at the same level as the junction; the outline of the cover or cover-plate not exceeding the outline of the supporting surface.

The distances between face C of the gauge and the outline of the side under test, measured parallel to face B, shall not decrease (with the exception of grooves, holes, reverse tapers or the like, placed at a distance less than 7 mm from a plane including face B and complying with the test of 24.18) when measurements are repeated, starting from point X in the direction of the arrow Y (see figure 34).

24.18 *A gauge according to figure 35, applied with a force of 1 N shall not enter more than 1,0 mm from the upper part of any groove, hole or reverse taper, or the like, when the gauge is applied parallel to the mounting/supporting surface and perpendicular to the part under test, as shown in figure 36.*

NOTE Verification as to whether, according to figure 35, the gauge has entered by more than 1,0 mm is made with reference to a surface perpendicular to face B and including the upper part of the outline of the grooves, holes, reverse tapers or the like.

25 Resistance to heat

Accessories and surface-type mounting boxes shall be resistant to heat.

Compliance is checked as follows:

a) for surface-type mounting boxes, separable covers, separable cover-plates and separable frames by the test of 25.3;

b) for portable accessories, with the exception of parts, if any, covered by a), by the tests of 25.1, 25.4 and, with the exception of parts made from natural or synthetic rubber or a mixture of both, by the test of 25.3;

c) for fixed socket-outlets, with the exception of parts, if any, covered by a), by the tests of 25.1, 25.2 and, with the exception of parts made from natural or synthetic rubber or a mixture of both, by the test of 25.3.

Parts intended only for decorative purposes, such as certain lids, are not submitted to this test.

25.1 *The specimens are kept for 1 h in a heating cabinet at a temperature of (100 ± 2) °C.*

During the test, they shall not undergo any change impairing their further use and sealing compound, if any, shall not flow to such an extent that live parts are exposed.

After the test, the specimens are then allowed to cool down to approximately room temperature. There shall be no access to live parts which are normally not accessible when the specimens are mounted as in normal use, even if the probe B of IEC 61032 is applied with a force not exceeding 5 N.

After the test, markings shall still be legible.

Discoloration, blisters or slight displacement of the sealing compound is disregarded, provided that safety is not impaired within the meaning of this standard.

25.2 *Parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position, as well as parts of the front surface zone of thermoplastic material, 2 mm wide, surrounding the phase and neutral pin entry holes of socket-outlets, shall be subjected to a ball-pressure test by means of the apparatus shown in figure 37, except that the insulating parts necessary to retain the earthing terminals in position in a box shall be tested as specified in 25.3.*

NOTE When it is not possible to carry out the test on the specimens, the test should be carried out on a piece at least 2 mm thick which is cut from the specimen. If this is not possible, no more than four layers, each cut from the same specimen, may be used, in which case the total thickness of the layers shall be not less than 2,5 mm.

The part under test shall be placed on a steel plate at least 3 mm thick and in direct contact with it.

The surface of the part to be tested is placed in the horizontal position and the hemispherical tip of the test equipment is pressed against the surface with a force of 20 N.

The test load and the supporting means shall be placed within the heating cabinet for a sufficient time to ensure that they have attained the stabilized testing temperature before the test commences.

The test is made in a heating cabinet at a temperature of (125 ± 2) °C.

After 1 h the ball shall be removed from the specimen, which is then immersed within 10 s, in cold water for cooling down to approximately room temperature.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

25.3 *Parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are subjected to a ball-pressure test in accordance with 25.2, but the test is made at a temperature of (70 ± 2) °C, or (40 ± 2) °C plus the highest temperature rise determined for the relevant part during the test of clause 19, whichever is the higher.*

25.4 *The specimens are subjected to a compression test by means of an apparatus as shown in figure 38, the test being made in a heating cabinet at a temperature of (80 ± 2) °C.*

The apparatus comprises two steel jaws, having a cylindrical face of 25 mm radius, a width of 15 mm and a length of 50 mm. The length of 50 mm can be increased, depending on the size of the accessory to be tested.

The corners are rounded with a radius of 2,5 mm.

The specimen is clamped between the jaws in such a way that these press against it in the area where it is gripped in normal use, the centre line of the jaws coinciding as nearly as possible with the centre of this area. The force applied through the jaws is 20 N.

After 1 h, the jaws are removed and the specimens shall show no damage within the meaning of this standard.

26 Screws, current-carrying parts and connections

26.1 Connections, electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.

Mechanical connections to be used during installation of accessories may be made using thread-forming screws or thread-cutting screws only when the screws are supplied together with the piece in which they are intended to be inserted. In addition, thread-cutting screws intended to be used during installation shall be captive with the relevant part of the accessory.

Screws or nuts which transmit contact pressure shall be in engagement with a metal thread.

Compliance is checked by inspection and, for screws and nuts transmitting contact pressure or which are operated when connecting up the accessory, by the following test.

NOTE 1 The requirements for the verification of terminals are given in clause 12.

The screws or nuts are tightened and loosened

- *10 times for screws in engagement with a thread of insulating material and for screws of insulating material*
- *five times for all other cases.*

Screws or nuts in engagement with a thread of insulating material and screws of insulating material are completely removed and reinserted each time.

The test is made by means of a suitable screwdriver or a suitable tool, applying a torque as specified in table 6.

During the test, no damage impairing the further use of the screwed connections shall occur, such as breakage of screws or damage to the head slots (rendering the use of an appropriate screwdriver impossible), threads, washers or stirrups.

NOTE 2 Screws or nuts which are operated when connecting up accessories include screws for fixing covers or cover plates, etc., but not connecting means for screwed conduits and screws for fixing the base of a fixed socket-outlet.

NOTE 3 The shape of the blade of the screw-driver used for the test should match the head of the screw to be tested. The screws and nuts should not be tightened in jerks. Damage to covers is ignored.

NOTE 4 Screwed connections are considered as partially checked by the tests of clauses 21 and 24.

26.2 For screws in engagement with a thread of insulating material which are operated when mounting the accessory during installation, their correct introduction into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by manual test.

NOTE The requirements with regard to correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

26.3 Electrical connections shall be designed in such a way that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

This requirement does not preclude designs with flat tinsel cord where the contact pressure is obtained from insulating parts having such properties as to ensure reliable and permanent contact under all conditions of normal use, especially in view of shrinking, ageing or cold flow of the insulating part.

Connections made by insulation piercing of tinsel cord shall be reliable.

Compliance is checked by inspection and, for the last requirement, by a test which is under consideration.

NOTE The suitability of the material is considered in relation to the stability of the dimensions.

26.4 Screws and rivets, which serve as electrical as well as mechanical connections, shall be locked against loosening and/or turning.

Compliance is checked by inspection and by manual test.

NOTE 1 Spring washers may provide satisfactory locking.

NOTE 2 For rivets, a non-circular shank or an appropriate notch may be sufficient.

NOTE 3 Sealing compound which softens on heating provides satisfactory locking only for screw connections not subjected to torsion in normal use.

26.5 Current-carrying parts, including those of terminals (as well as earthing terminals), shall be of metal having, under the conditions occurring in the accessory, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Compliance is checked by inspection and, if necessary, by chemical analysis.

NOTE Examples of suitable metals, when used within the permissible temperature range and under normal conditions of chemical pollution, are as follows:

– copper;
– an alloy containing at least 58 % copper for parts made from cold-rolled sheet or at least 50 % copper for other parts;
– stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
– steel provided with an electroplated coating of zinc according to ISO 2081, the coating having a thickness of at least

  5 ∝m, service condition ISO no. 1, for accessories classified IP code IPX0;

  12 ∝m, service condition ISO no. 2, for accessories classified IP code IPX4;

  25 ∝m, service condition ISO no. 3, for accessories classified IP code IPX5;
– steel provided with an electroplated coating of nickel and chromium according to ISO 1456, the coating having a thickness of at least

  20 ∝m, service condition ISO no. 2, for accessories classified IP code IPX0;

  30 ∝m, service condition ISO no. 3, for accessories classified IP code IPX4;

  40 ∝m, service condition ISO no. 4, for accessories classified IP code IPX5;
– steel provided with an electroplated coating of tin according to ISO 2093, the coating having a thickness of at least

  12 ∝m, service condition ISO no. 2, for accessories classified IP code IPX0;

  20 ∝m, service condition ISO no. 3, for accessories classified IP code IPX4;

  30 ∝m, service condition ISO no. 4, for accessories classified IP code IPX5.

Current-carrying parts which may be subjected to mechanical wear shall not be made of steel provided with an electroplated coating.

Under moist conditions, metals showing a great difference of electromechanical potential with respect to each other shall not be used in contact with each other.

Compliance is checked by a test which is under consideration.

NOTE The requirement of this subclause does not apply to screws, nuts, washers, clamping plates and similar parts of terminals.

26.6 Contacts which are subjected to a sliding action in normal use shall be of a metal resistant to corrosion.

Compliance with the requirements of 26.5 and 26.6 is checked by inspection and, in case of doubt, by chemical analysis.

26.7 Thread-forming screws and thread-cutting screws shall not be used for the connection of current-carrying parts.

Thread-forming screws and thread-cutting screws may be used to provide earthing continuity, provided that it is not necessary to disturb the connection in normal use and that at least two screws are used for each connection.

Compliance is checked by inspection.

27 Creepage distances, clearances and distances through sealing compound

27.1 Creepage distances, clearances and distances through sealing compound shall be not less than the values shown in table 23.

Table 23 – Creepage distances, clearances and distances through insulating sealing compound

Description	mm
Creepage distance:	
1 between live parts of different polarity	4[a]
2 between live parts and	
– accessible surface of parts of insulating material	3
– earthed metal parts including parts of earthing circuit	3
– metal frames supporting the base of flush-type socket-outlets	3
– screws or devices for fixing bases, covers or cover-plates of fixed socket-outlets	3
– external assembly screws, other than screws which are on the engagement face of plugs and are isolated from the earthing circuit	3
3 between pins of plugs and metal parts connected to them, when fully engaged, and a socket-outlet of the same system having accessible unearthed metal parts[b], made according to the most unfavourable construction[c]	6[d]
4 between the accessible unearthed metal parts[b] of a socket-outlet and a fully engaged plug of the same system having pins and metal parts connected to them made according to the most unfavourable construction[c]	6[d]
5 between live parts of a socket-outlet (without a plug) or of a plug and their accessible unearthed or functional earthed metal parts[b]	6[d]
Clearance:	
6 between live parts of different polarity	3
7 between live parts and	
– accessible surface of parts of insulating material	3
– earthed metal parts not mentioned under items 8 and 9 including parts of earthing circuit,	3
– metal frames supporting the base of flush-type socket-outlets	3
– screws or devices for fixing bases, covers or cover-plates of fixed socket-outlets	3
– external assembly screws, other than screws which are on the engagement face of plugs and are isolated from the earthing circuit	3
8 between live parts and	
– exclusively earthed metal boxes[e] with the socket-outlet in the most unfavourable position	3
– unearthed metal boxes, without insulating lining with the socket-outlet in the most unfavourable position	4,5
– accessible unearthed or functional earthed metal parts of socket-outlets and plugs	6
9 between live parts and the surfaces on which the base of a socket-outlet for surface mounting is mounted	6
10 between live parts and the bottom of any conductor recess, if any, in the base of a socket-outlet for surface mounting	3
Distance through insulating sealing compound:	
11 between live parts covered with at least 2 mm of sealing compound and the surface on which the base of a socket-outlet for surface mounting is mounted	4[a]
12 between live parts covered with at least 2 mm of sealing compound and the bottom of any conductor recess, if any, in the base of a socket-outlet for surface mounting	2,5

[a] This value is reduced to 3 mm for accessories having a rated voltage up to and including 250 V.

[b] With exception of screws and the like.

[c] The most unfavourable construction may be checked by means of a gauge which is based on the standard sheets relevant to the system concerned.

[d] This value is reduced to 4,5 mm for accessories having a rated voltage up to and including 250 V.

[e] Exclusively earthed metal boxes are those suitable only for use in installations where earthing of metal boxes is required.

Compliance is checked by measurement.

For rewirable accessories, the measurements are made on the specimen fitted with conductors of the largest nominal cross-sectional area specified in table 3 and also without conductors.

The conductor shall be inserted into the terminal and connected in such a way that the core insulation touches the metal part of the clamping unit or, where the core insulation is prevented by construction from touching the metal part, the outside of the obstruction.

For non-rewirable accessories, the measurements are made on the specimen as delivered.

Socket-outlets are checked when in engagement with a plug and also without a plug.

Distances through slots or openings in external parts of insulating material are measured using a metal foil in contact with the accessible surface other than the engagement face of plugs. The foil is pushed into corners and the like by means of the test probe 11 of IEC 61032, but is not pressed into openings.

For surface-type socket-outlets classified IP20 according to IEC 60529, the most unfavourable conduit or cable is introduced for a distance of 1 mm into the socket-outlet in accordance with 13.22. If the metal frame supporting the base of a flush-type socket-outlet is movable, this frame is placed in the most unfavourable position.

NOTE 1 The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width.

NOTE 2 Any air-gap less than 1 mm wide is ignored in computing the total clearance.

NOTE 3 The surface on which the base of a socket-outlet for surface mounting is mounted includes any surface in contact with the base when the socket-outlet is installed. If the base is provided with a metal plate at the back, this plate is not regarded as the mounting surface.

27.2 Insulating sealing compound shall not protrude above the edge of the cavity in which it is contained.

27.3 Surface-type socket-outlets shall not have bare current-carrying strips at the back.

Compliance with the requirements of 27.2 and 27.3 is checked by inspection.

28 Resistance of insulating material to abnormal heat, to fire and to tracking

28.1 Resistance to abnormal heat and to fire

Parts of insulating material which might be exposed to thermal stresses due to electric effects, and the deterioration of which might impair the safety of the accessory, shall not be unduly affected by abnormal heat and by fire.

Compliance is checked by the test of 28.1.1 and, in addition, for plugs with pins provided with insulating sleeves, by the test of 28.1.2

28.1.1 Glow-wire test

The test is performed according to IEC 60695-2-10 and IEC 60695-2-11 under the following conditions:

– *for parts made of insulating material, necessary to retain current-carrying parts and parts of the earthing circuit of fixed accessories in position, by the test made at 850 °C, with the exception of parts of insulating material needed to retain the earth terminal in position in a box, which shall be tested at a temperature of 650 °C;*

NOTE 1 Side earthing contacts fixed to the main part (base) of the socket-outlet are not considered to be retained in position by a removable cover when the plug is not inserted.

– *for parts of insulating material, necessary to retain current-carrying parts, and parts of the earthing circuit of portable accessories in position, by the test made at a temperature of 750 °C;*

– *for parts of insulating material, not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, by the test made at a temperature of 650 °C.*

If the tests specified have to be made at more than one place on the same specimen, care shall be taken to ensure that any deterioration caused by previous tests does not affect the result of the test to be made.

Small parts, where each surface lies completely within a circle of 15 mm diameter, or where any part of the surface lies outside a 15 mm diameter circle and where it is not possible to fit a circle of 8 mm diameter on any of the surfaces, are not subjected to the test of this subclause (see figure 39 for diagrammatic representation).

NOTE 2 When checking a surface, projections on the surfaces and holes which are not greater than 2 mm on the largest dimension are disregarded.

The tests are not made on parts of ceramic material.

NOTE 3 The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part of insulating material, which might be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested parts onto the pinewood board covered with a tissue paper.

If possible, the specimen should be a complete accessory.

NOTE 4 If the test cannot be made on a complete accessory, a suitable part may be cut from it for the purpose of the test.

The test is made on one specimen.

The test is made applying the glow-wire once.

In case of doubt, the test shall be repeated on two further specimens.

The specimen shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

The tip of the glow-wire shall be applied to the specified surface of the specimen taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the specimen.

The specimen is regarded as having passed the glow-wire test if

– *there is no visible flame and no sustained glowing, or if*

– *flames and glowing at the specimen extinguish within 30 s after removal of the glow-wire.*

There shall be no ignition of the tissue paper or scorching of the board.

28.1.2 *The specimen of a plug with pins provided with insulating sleeves is tested by means of the test apparatus as shown in figure 40.*

This test apparatus consists of an insulating plate A and of a metal part B: between these two parts an air space of 3 mm shall be provided and this distance shall be obtained through means which do not impair the air circulation around the pins.

The front surface of the insulating plate A shall be round and flat and have a diameter equal to twice the maximum permissible dimension of the engagement face of the plug given in the relevant standard sheet.

The thickness of this insulating plate shall be 5 mm.

The metal part B shall be of brass and have, for a distance of at least 20 mm, the same shape as the maximum outline of the plug according to the relevant standard sheet.

The rest of this metal part shall be so shaped that the accessory under test is heated through it by conduction, and the heat transmission to the accessory under test by convection or radiation is reduced to a minimum.

A thermocouple shall be inserted at a distance of 7 mm from the front surface of the metal part in a symmetrical position, as shown in figure 40.

The dimensions of the holes for the pins in the metal part B shall be 0,1 mm larger than the maximum dimensions of the pins given in the relevant standard sheet and the distances between the pins shall be the same as those given in the relevant standard sheet; the depth of the holes shall be sufficient.

NOTE 1 The metal part B can be made of two or more component pieces, for hole cleaning purposes.

The specimens are inserted in the test apparatus, placed in the most unfavourable horizontal position, when the test apparatus has reached a steady temperature, measured by means of the thermocouple, of (120 ± 5) °C for accessories having a rated current of 2,5 A, and (180 ± 5) °C for accessories having a higher current rating.

The temperature is maintained at the relevant values for 3 h.

The specimens are then taken out from the test apparatus and are allowed to cool down to room temperature, at which they are maintained for at least 4 h.

The insulating sleeves of the pins of the specimens are then submitted to an impact test in accordance with clause 30 but made at ambient temperature, and subject to visual inspection.

NOTE 2 During visual inspection, no cracks on the insulating sleeves should be visible with normal or corrected vision without additional magnification, and the dimensions of the insulating sleeves should not have changed so as to impair protection against accidental contact.

28.2 Resistance to tracking

For accessories having an IP code higher than IPX0, parts of insulating material retaining live parts in position shall be of material resistant to tracking.

Compliance is checked according to IEC 60112.

Ceramic parts are not tested.

A flat surface of the part to be tested, if possible at least (15 15) mm, is placed in a horizontal position.

The material under test shall pass a proof-tracking index of 175 using test solution A with an interval between drops of (30 ± 5) s.

No flashover or breakdown between electrodes shall occur before a total of 50 drops has fallen.

29 Resistance to rusting

Ferrous parts, including covers and surface-mounting boxes, shall be adequately protected against rusting.

Compliance is checked by the following test.

All grease is removed from the parts to be tested, using a suitable degreasing agent.

The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of (20 ± 5) °C.

After the parts have been dried for 10 min in a heating cabinet at a temperature of (100 ± 5) °C, their surfaces shall show no signs of rust.

NOTE 1 Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

NOTE 2 For small springs and the like, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

30 Additional tests on pins provided with insulating sleeves

The material of pin-insulating sleeves shall be resistant to the stresses to which it may be subjected at high temperature, likely to occur in conditions approaching bad connection conditions, and at low temperatures in particular conditions of service.

Compliance is checked by means of the following tests.

30.1 Pressure test at high temperature

The specimens are tested by means of the apparatus shown in figure 41. This apparatus has a rectangular blade (see figure 41a) with an edge 0,7 mm wide, to be used in the case of round pins, or a blade having a round shape (see figure 41b), with a diameter of 6 mm and an edge of 0,7 mm, in other cases.

The specimens are placed in position as shown in figure 41.

The force applied through the blade is 2,5 N.

The apparatus, with the specimen in position, is maintained for 2 h in a heating cabinet at a temperature of (200 ± 5) °C.

The specimen is then removed from the apparatus and, within 10 s, cooled by immersion in cold water.

The thickness of the insulation is measured immediately at the point of impression.

The thickness within the area of the impression shall be not less than 50 % of the thickness measured before the test.

NOTE The values 2,5 N and (200 ± 5) °C are provisional.

30.2 Static damp heat test

A set of three specimens is submitted to two damp heat cycles in accordance with IEC 60068-2-30.

After this treatment and after regaining ambient temperature, the specimens are submitted to the following tests:

- *insulation resistance and electric strength test, in accordance with clause 17,*
- *abrasion test, in accordance with 24.7.*

30.3 Test at low temperature

A set of three specimens is maintained at (–15 ± 2) °C for 24 h.

After regaining ambient temperature, the specimens are submitted to the following tests:

- *insulation resistance and electric strength test, in accordance with clause 17;*
- *abrasion test, in accordance with 24.7.*

30.4 Impact test at low temperature

The specimens are subjected to an impact test by means of the apparatus as shown in figure 42. The mass of the falling weight is (100 ± 1) g.

The apparatus, on a sponge rubber pad, 40 mm thick, is placed, together with the specimens, in a freezer at a temperature of (–15 ± 2) °C for at least 24 h.

At the end of this period, each specimen in turn, is placed in position, as shown in figure 42, and the falling weight is allowed to fall from a height of 100 mm. Four impacts are applied successively to the same specimen, rotating it through 90° between impacts.

After the test the specimens are allowed to attain approximately room temperature and are then examined.

No cracks of the insulating sleeves shall be visible with normal or corrected vision without additional magnification.

NOTE The cooling period of 24 h, mentioned in the tests of 30.3 and 30.4, includes the time necessary for cooling down the apparatus.

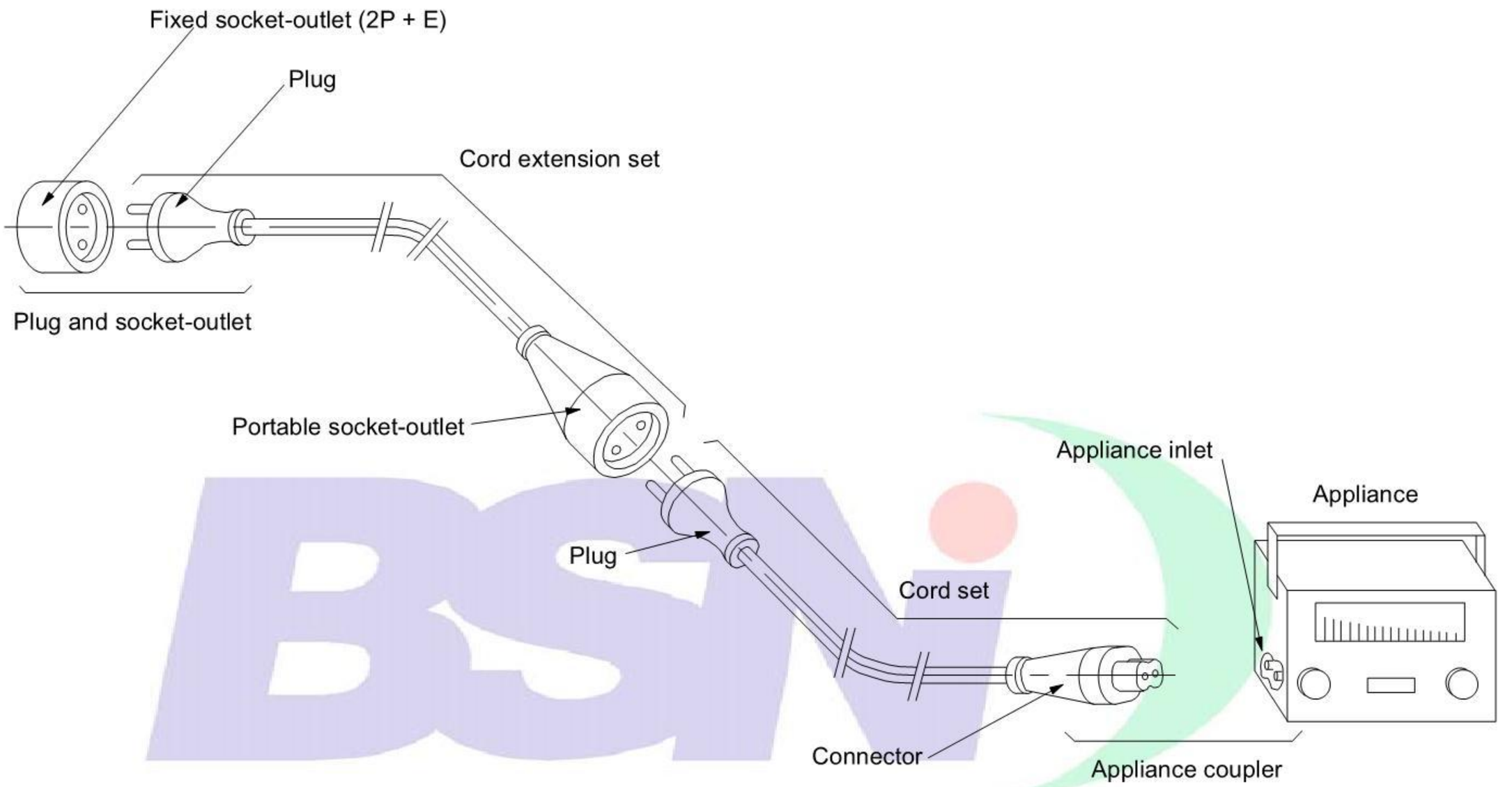
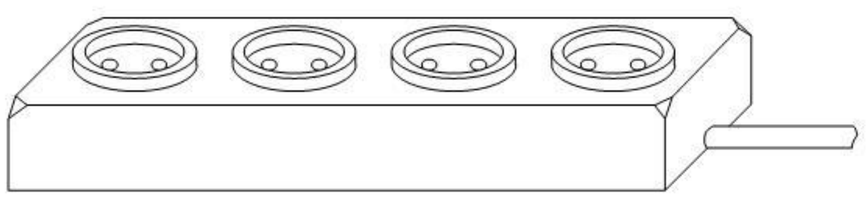


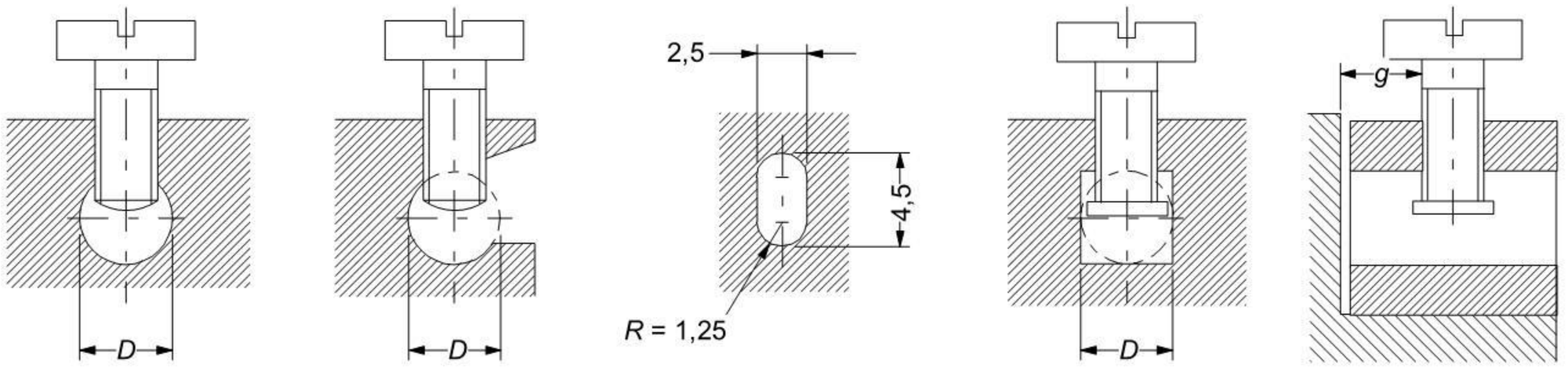
Figure 1a – Diagram showing various accessories and their use



IEC 1312/02

Figure 1b – Multiple portable socket-outlet (table type)

Figure 1 – Example of accessories



Terminals without pressure plate | Elongated hole terminal | Terminals with pressure plate

IEC 1313/02

Dimensions in millimetres

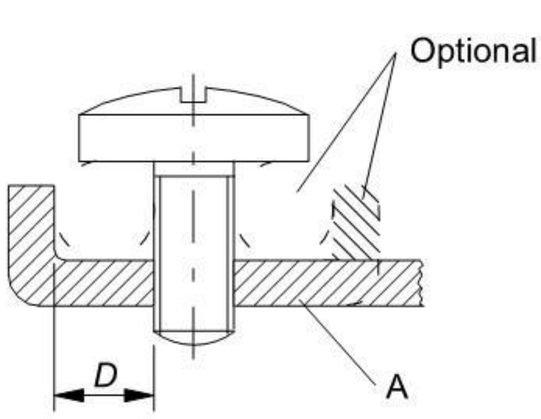
Cross-section of conductor accepted by the terminal mm²	**Minimum diameter *D* (or minimum dimensions) of conductor space** mm	**Minimum distance *g* between clamping screw and end of conductor when fully inserted** mm		**Torque** Nm					
				1[a]		**2**[a]		**3**[a]	
		One screw	Two screws	One screw	Two screws	One screw	Two screws	One screw	Two screws
Up to 1,5	2,5	1,5	1,5	0,2	0,2	0,4	0,4	0,4	0,4
2,5 (circular hole)	3,0	1,5	1,5	0,25	0,2	0,5	0,4	0,5	0,4
2,5 (elongated hole)	2,5 4,5	1,5	1,5	0,25	0,2	0,5	0,4	0,5	0,4
4	3,6	1,8	1,5	0,4	0,2	0,8	0,4	0,8	0,4
6	4,0	1,8	1,5	0,4	0,25	0,8	0,5	0,8	0,5
10	4,5	2,0	1,5	0,7	0,25	1,2	0,5	1,2	0,5

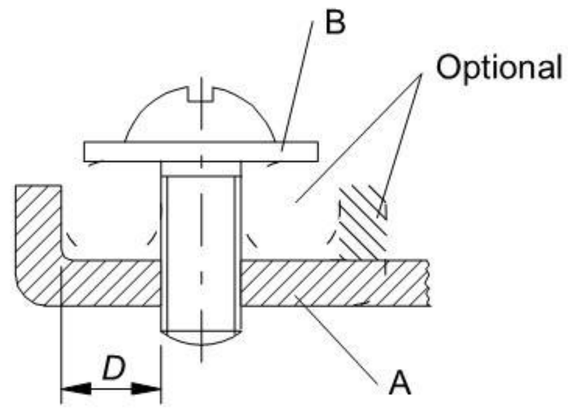
[a] The values specified apply to screws covered by the corresponding columns in table 6.

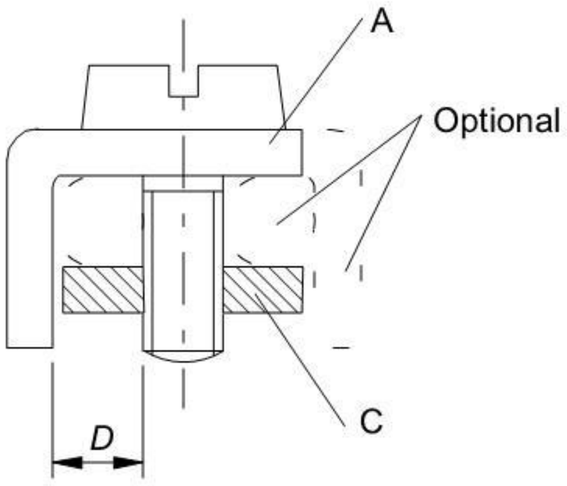
The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with a stirrup.

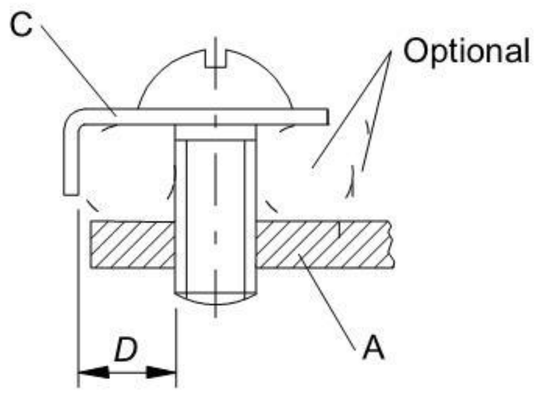
The shape of the conductor space may differ from those shown, provided that a circle with a diameter equal to the minimum specified for *D* or the minimum outline specified for the elongated hole accepting cross-sections of conductors up to 2,5 mm² can be inscribed.

Figure 2 – Pillar terminals

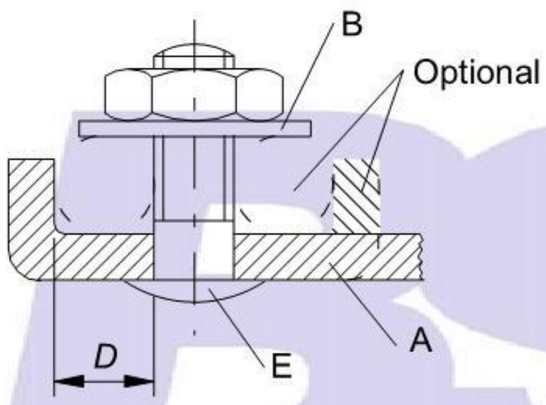


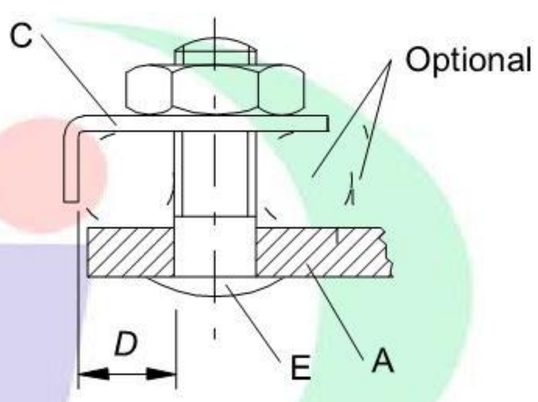






Screw terminals





Stud terminals

IEC 1314/02

Key

A Fixed part
B Washer or clamping plate
C Anti-spread device
D Conductor space
E Stud

Figure 3a – Screw/stud not requiring washer or clamping plate

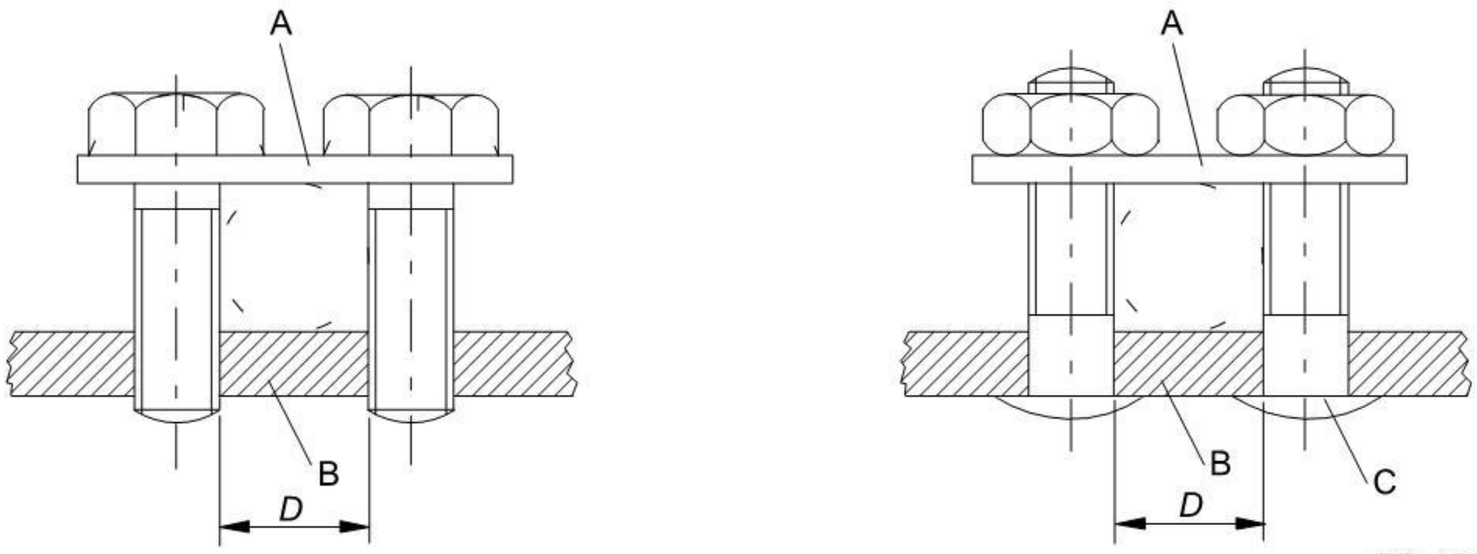
Figure 3b – Screw/stud requiring washer, clamping plate or anti-spread device

Cross-section of conductor accepted by the terminal mm²	**Minimum diameter *D* of conductor space** mm	**Torque**	
		3[a]	
		One screw or stud	**Two screws or studs**
Up to 1,5	1,7	0,5	–
Up to 2,5	2,0	0,8	–
Up to 4	2,7	1,2	0,5
Up to 6	3,6	2,0	1,2
Up to 10	4,3	2,0	1,2
[a] The values specified apply to the screws covered by the corresponding columns in table 6.			

The part which retains the conductor in position may be of insulating material provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

The second optional space for the terminal accepting cross-section of conductors up to 2,5 mm² may be used for the connection of the second conductor when it is required to connect two 2,5 mm² conductors.

Figure 3 – Screw terminals and stud terminals



IEC 1315/02

Key

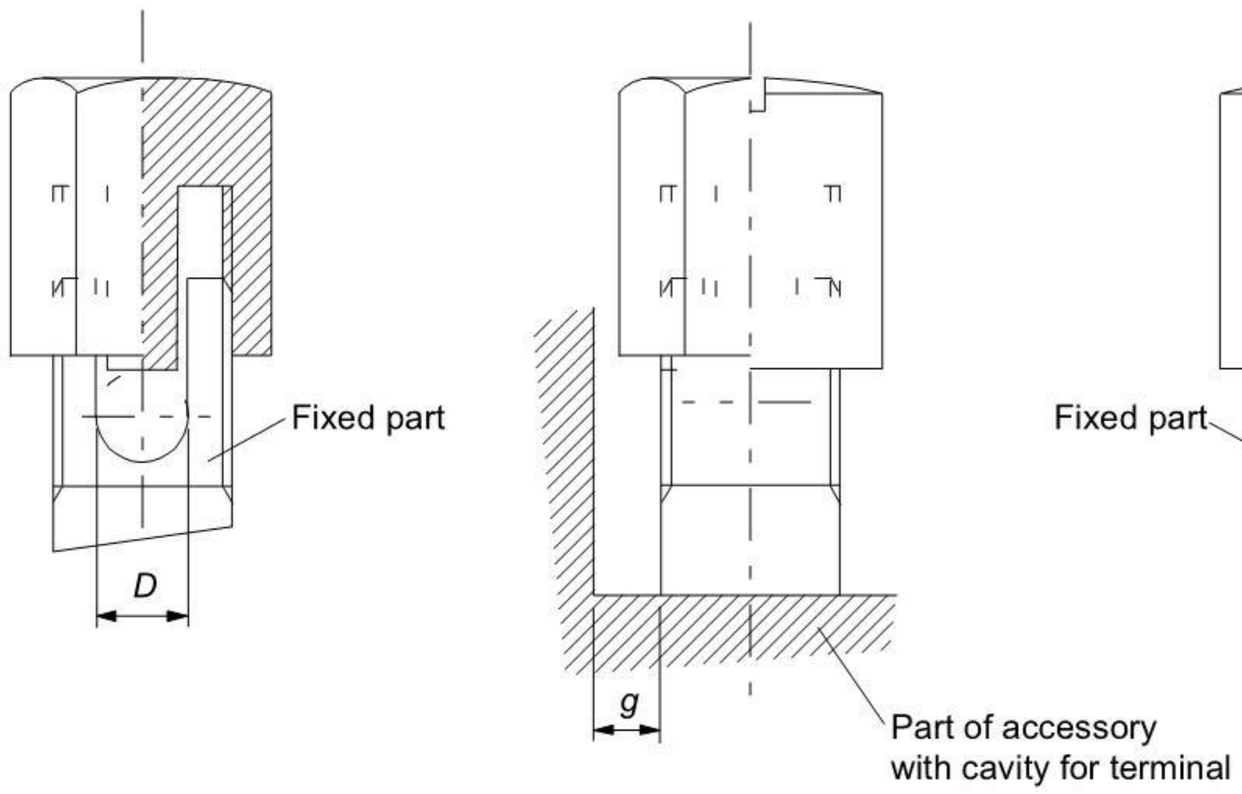
A Saddle
B Fixed part
C Stud
D Conductor space

Cross-section of conductor accepted by the terminal mm²	**Minimum diameter *D* of conductor space** mm	**Torque** Nm
Up to 4	3,0	0,5
Up to 6	4,0	0,8
Up to 10	4,5	1,2

The shape of the conductor space may differ from that shown in the figure, provided that a circle with a diameter equal to the minimum value specified for *D* can be inscribed.

The shape of the upper and lower faces of the saddle may have a different shape to accommodate conductors of either small or large cross-sectional areas by inverting the saddle.

Figure 4 – Saddle terminals



Cross-section of conductor accepted by the terminal mm²	Minimum diameter *D* of conductor space [a] mm	Minimum distance *g* between fixed part and end of conductor when fully inserted mm
Up to 1,5	1,7	1,5
Up to 2,5	2,0	1,5
Up to 4	2,7	1,8
Up to 6	3,6	1,8
Up to 10	4,3	2,0
[a] The bottom of the conductor space must be slightly rounded in order to obtain a reliable connection.		

NOTE The value of the torque to be applied is that specified in column 2 or 3 of table 6 as appropriate.

Figure 5 – Mantle terminals

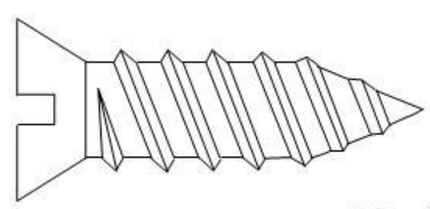


Figure 6 – Example of thread-forming screw

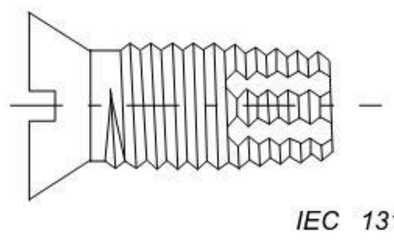
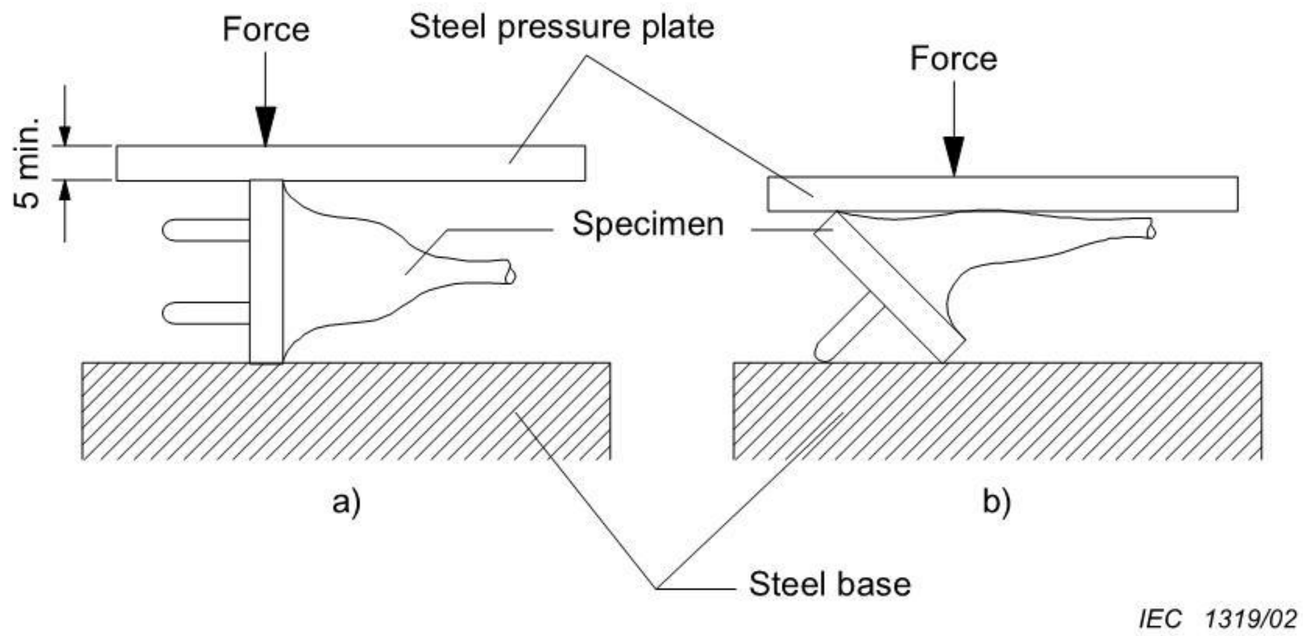
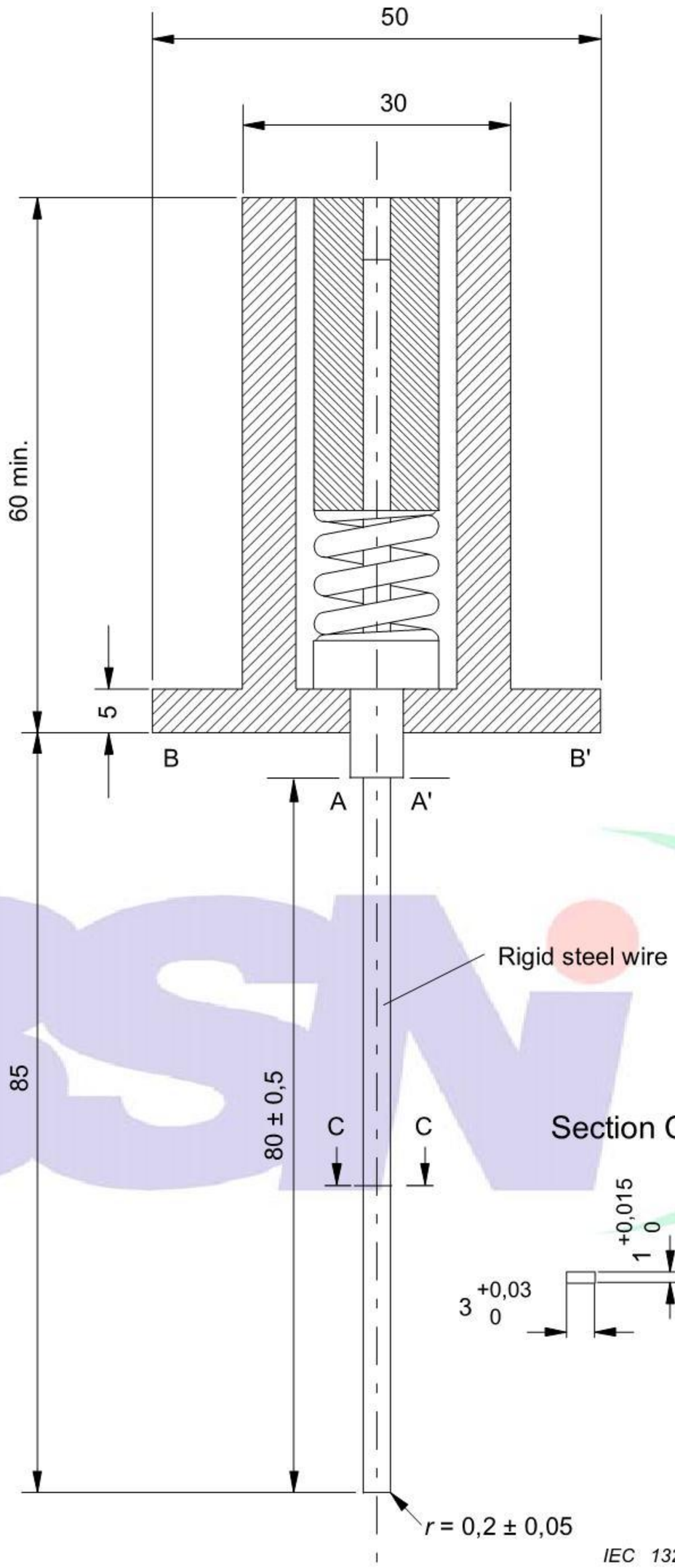


Figure 7 – Example of thread-cutting screw



Dimensions in millimetres

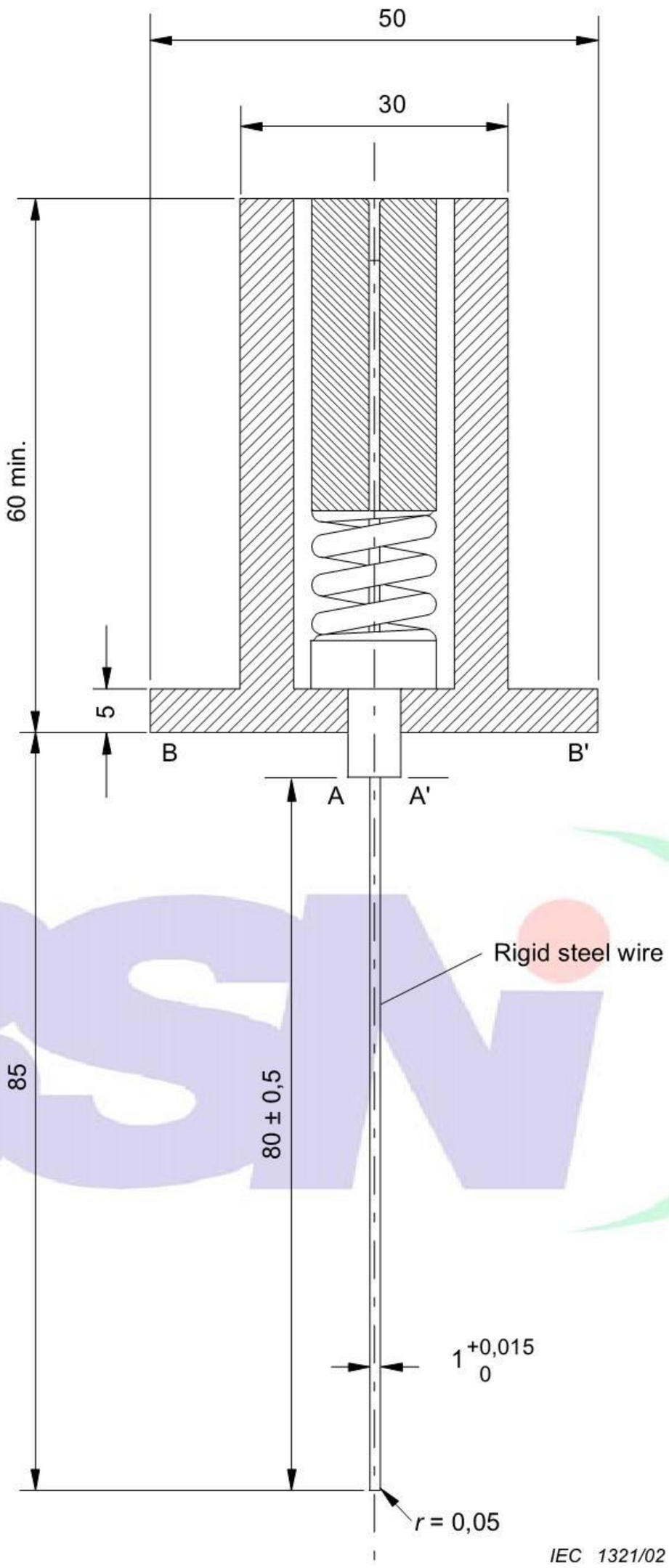
Figure 8 – Arrangement for compression test of 24.5



Dimensions in millimetres

To calibrate the gauge, a push force of 20 N is applied on the steel rigid wire in the direction of its axis: the characteristics of the gauge internal spring shall be such that the surface A – A is brought practically to the same level as the surface B – B when this force is applied.

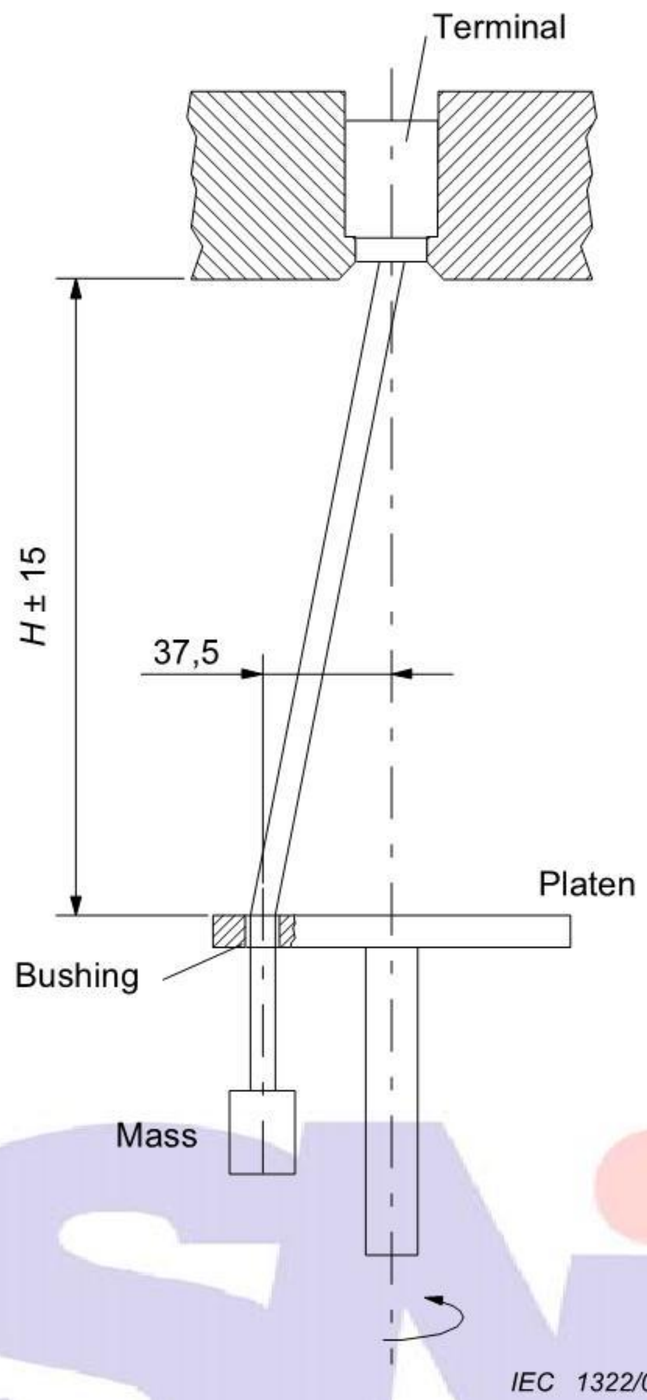
Figure 9 – Gauge for checking non-accessibility of live parts, through shutters



Dimensions in millimetres

To calibrate the gauge, a push force of 1 N is applied on the steel rigid wire in the direction of its axis: the characteristics of the gauge internal spring shall be such that the surface A – A is brought practically to the same level as the surface B – B when this force is applied.

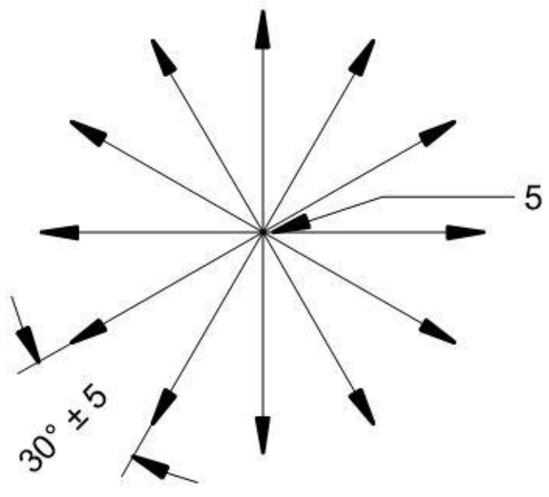
Figure 10 – Gauge for checking non-accessibility of live parts, through shutters, and of live parts of socket-outlets with increased protection

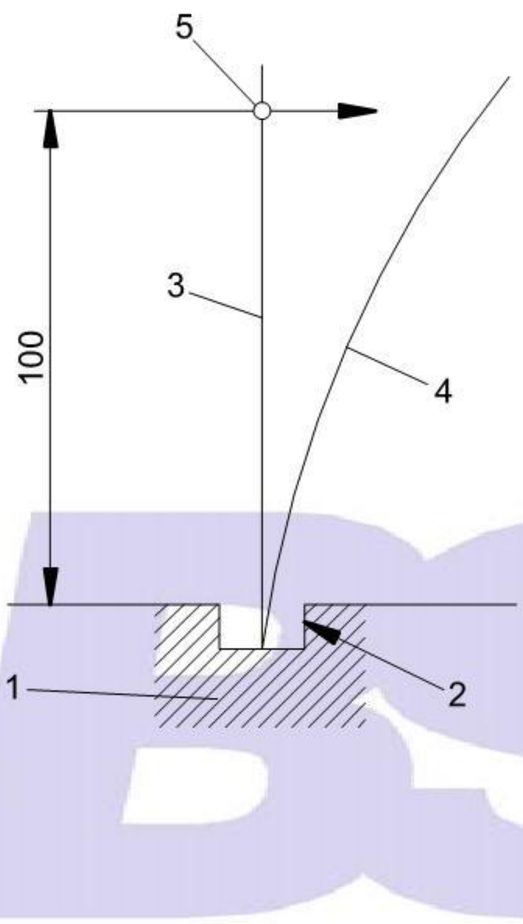


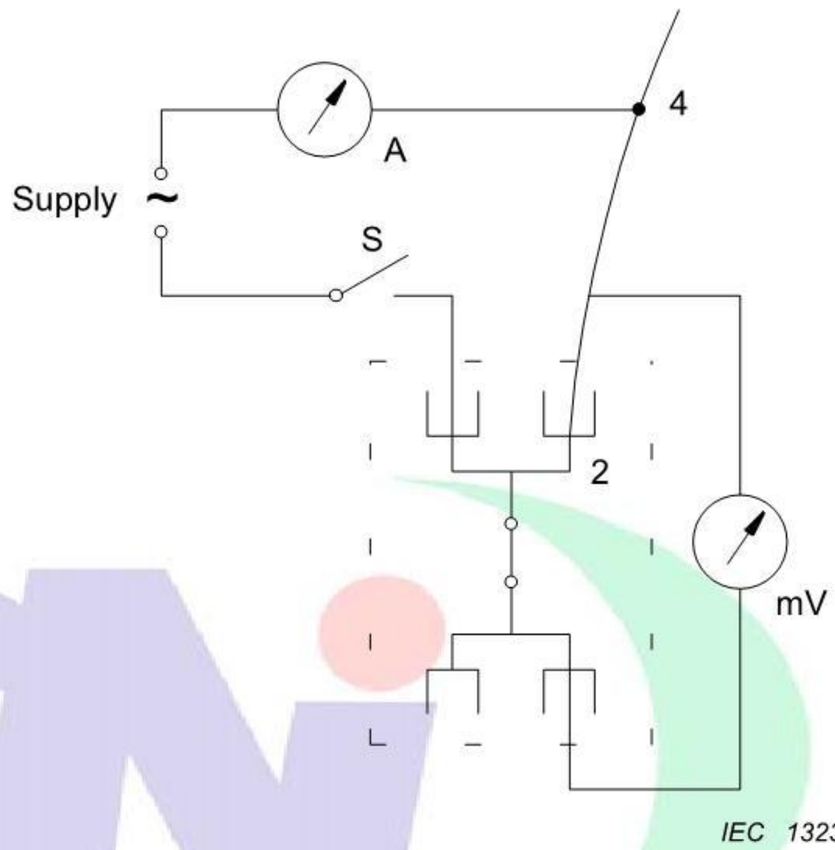
Dimensions in millimetres

NOTE Care should be taken that the bushing hole is made in a way which ensures that the force extended to the cable is pure pulling force and that the transmission of any torque to the connection in the clamping means is avoided.

Figure 11 – Arrangement for checking damage to conductors







IEC 1323/02

Dimensions in millimetres

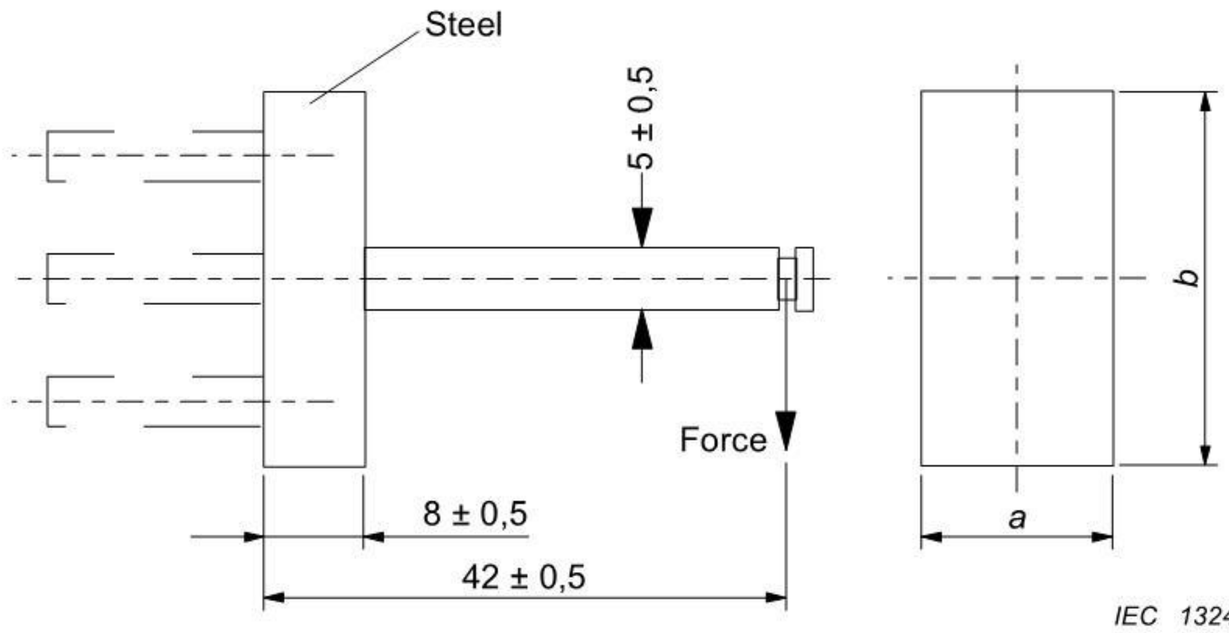
Key

A	Ammeter
mV	Millivoltmetre
S	Switch
1	Sample
2	Clamping unit under test
3	Test conductor
4	Test conductor, deflected
5	Point of application of the force for deflecting the conductor
6	Deflection force (perpendicular to the straight conductor)

Figure 12a – Principle of the test apparatus for deflection on screwless terminals

Figure 12b – Example of test arrangement to measure the voltage drop during deflection test on screwless terminals

Figure 12 – Information for deflection test



Dimensions in millimetres

NOTE 1 The dimensions *a* and *b* should be chosen according to the appropriate standard sheets.

NOTE 2 Dimensions and arrangement of pins in compliance with standard sheets.

Figure 13 – Device for checking the resistance to lateral strain

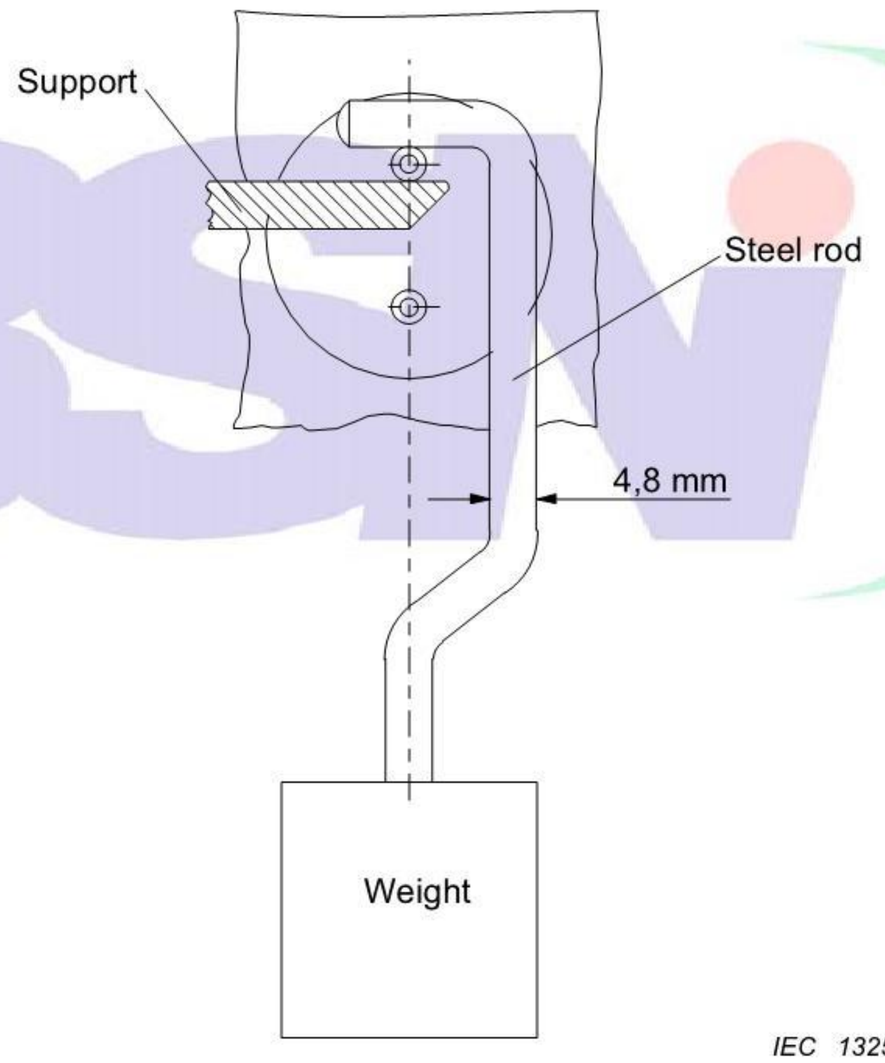
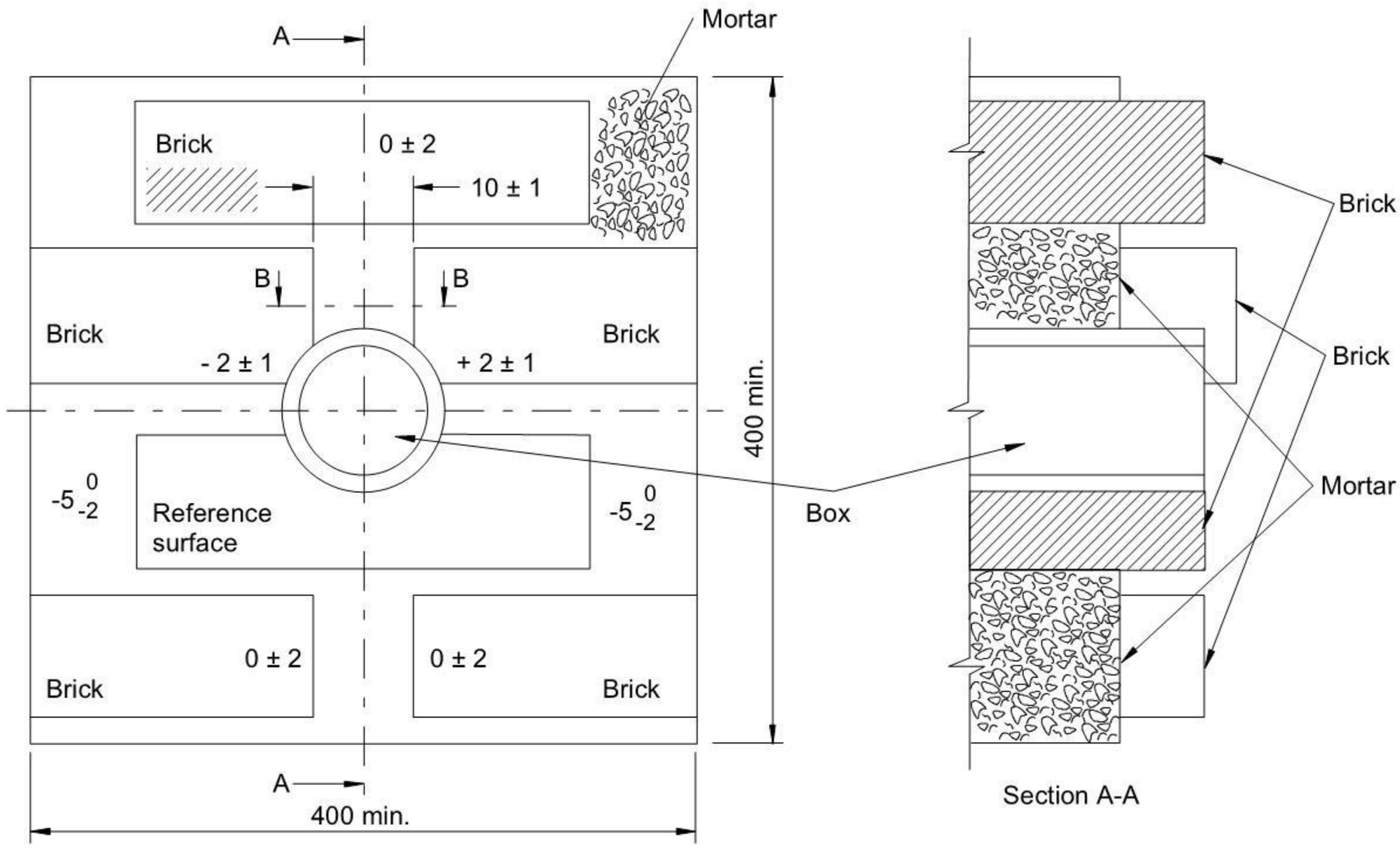
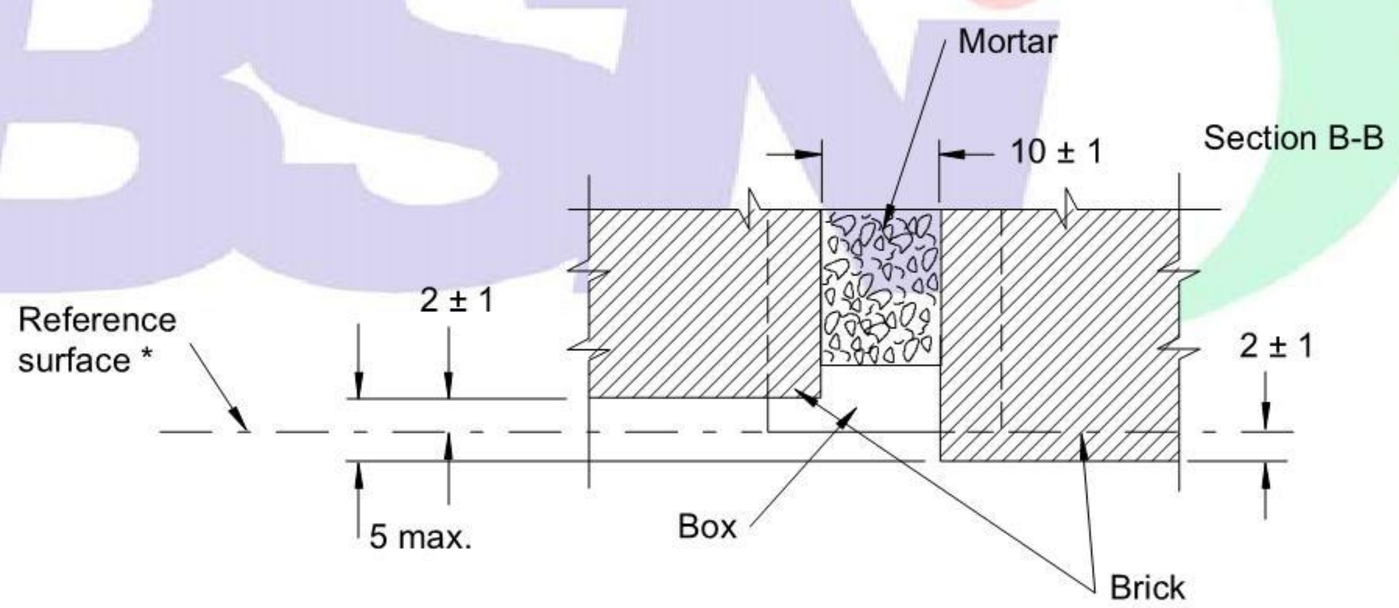


Figure 14 – Device for testing non-solid pins



All mortar joints 10 ± 5 mm thick unless otherwise specified

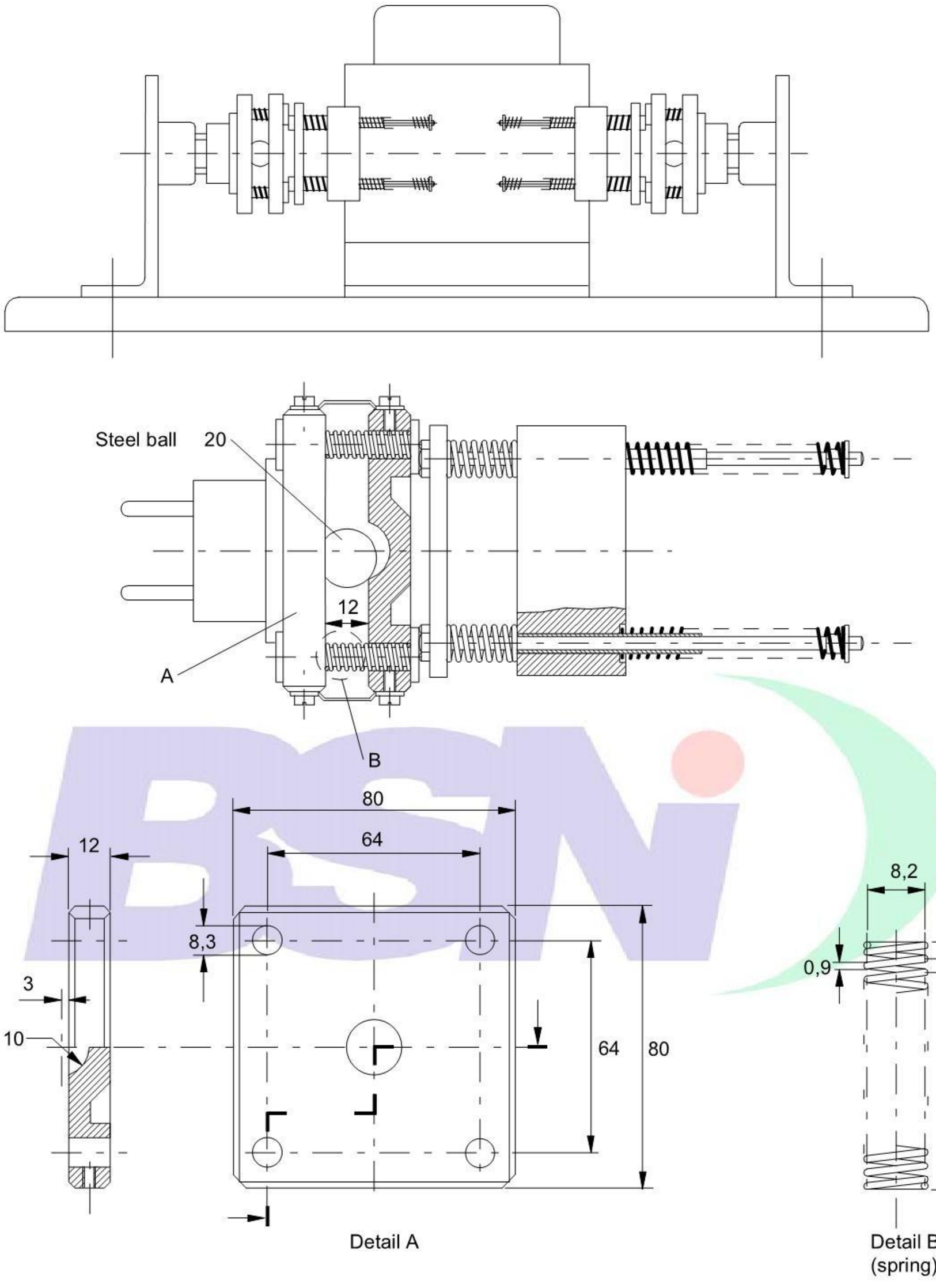


* or in accordance with the manufacturer's instructions

IEC 1326/02

Dimensions in millimetres

Figure 15 – Test wall in accordance with the requirements of 16.2.1



Dimensions in millimetres

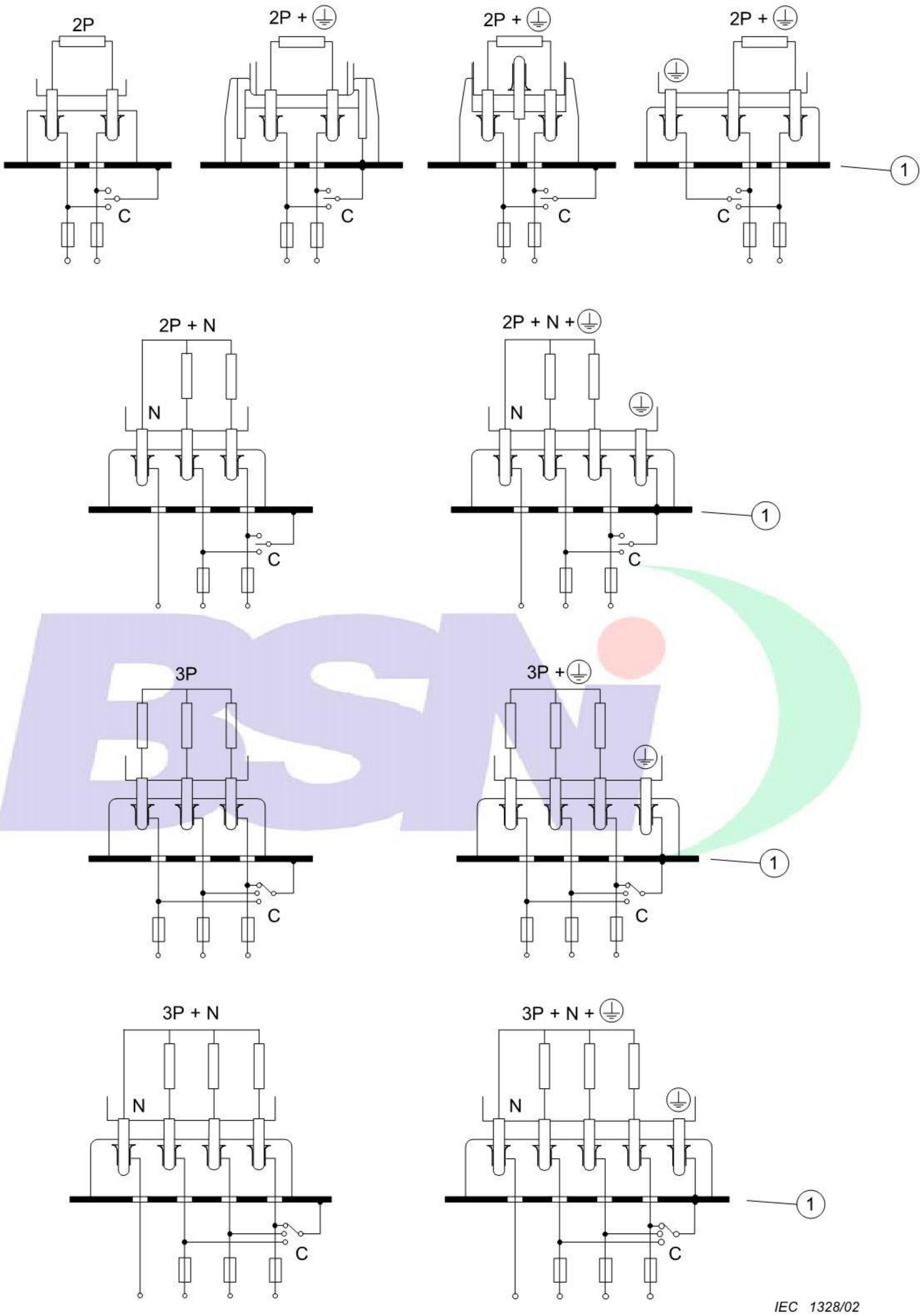
The springs, other than springs B, shall be chosen and adjusted in such a way that:

in the disengaged position they exert a force on the plug carrier as specified in the following table:

Rating	Number of poles	Force on the plug carrier N
Up to and including 10 A	2	3,5
	3	4,5
Above 10 A up to and including 16 A	2	7,2
	3	8,1
	More than 3	9
Above 16 A up to and including 32 A	2	12,6
	3	12,6
	More than 3	14,4

When compressed by one-third of the difference between the length in the disengaged position and the fully compressed length, they exert a force equal to 1,2 times the appropriate maximum withdrawal force specified in clause 22.

Figure 16 – Example of apparatus for breaking capacity and normal operation test

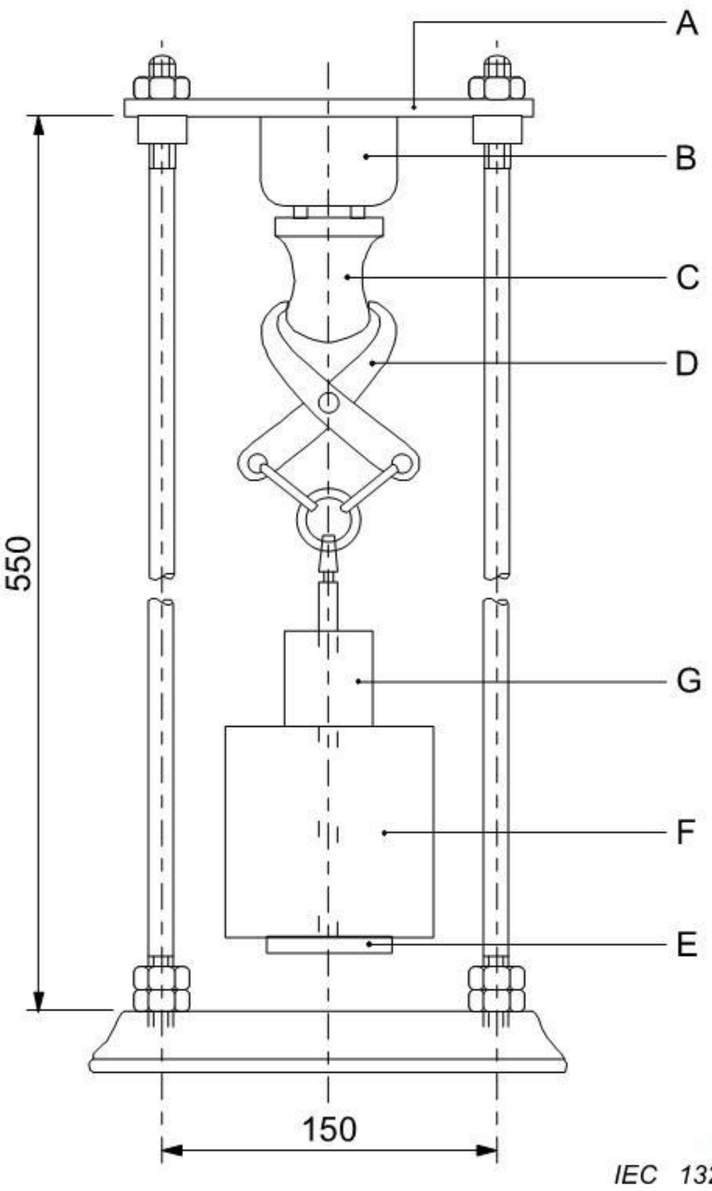


IEC 1328/02

Key

1 Metal support

Figure 17 – Circuit diagrams for breaking capacity and normal operation tests



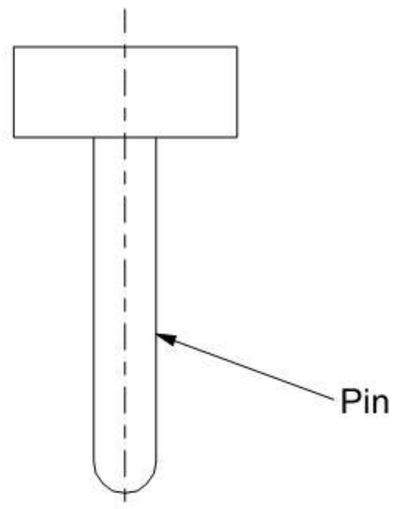
IEC 1329/02

Dimensions in millimetres

Components

A Mounting plate
B Specimen
C Test plug
D Clamp
E Carrier
F Principal weight
G Supplementary weight

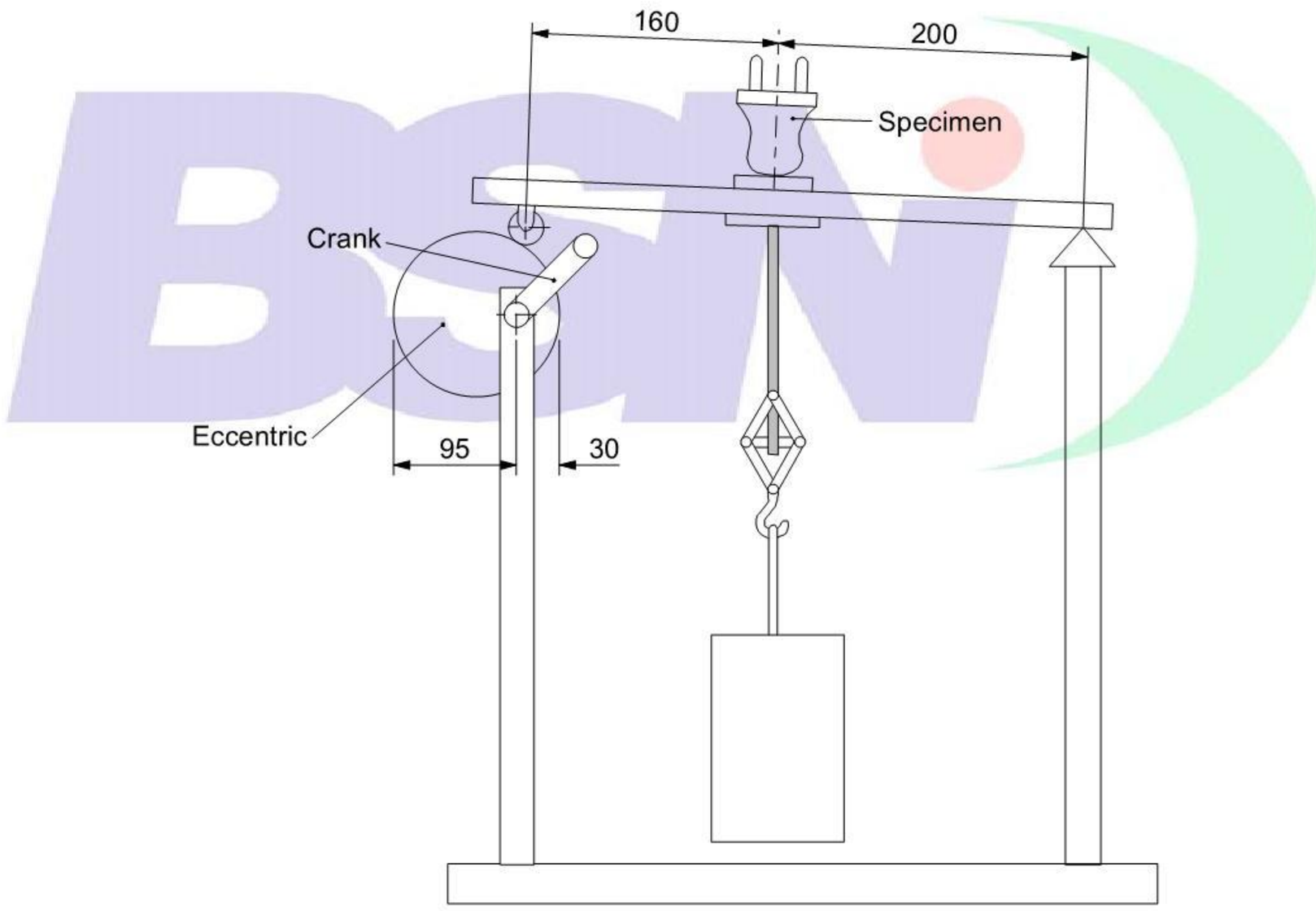
Figure 18 – Apparatus for verification of maximum withdrawal force



NOTE 1 The mass should be equally positioned around the centreline(s) of the pin.

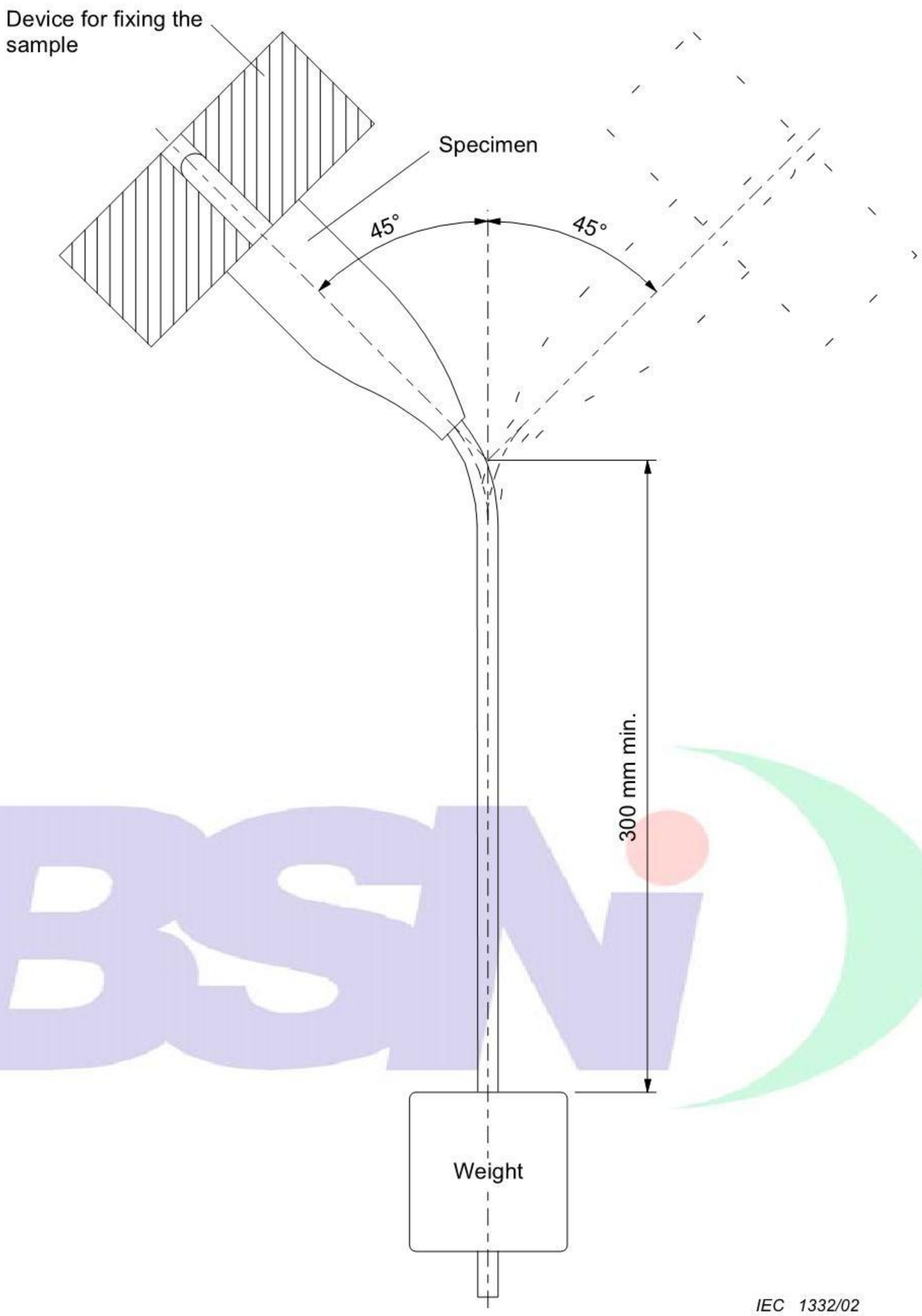
NOTE 2 Dimensions according to the relevant standard sheet.

Figure 19 – Gauge for the verification of minimum withdrawal force



Dimensions in millimetres

Figure 20 – Apparatus for testing cord retention



An adjustment of the different supports for the accessories by means of a threaded spindle shall be provided according to the explanation in 23.4.

Figure 21 – Apparatus for flexing test

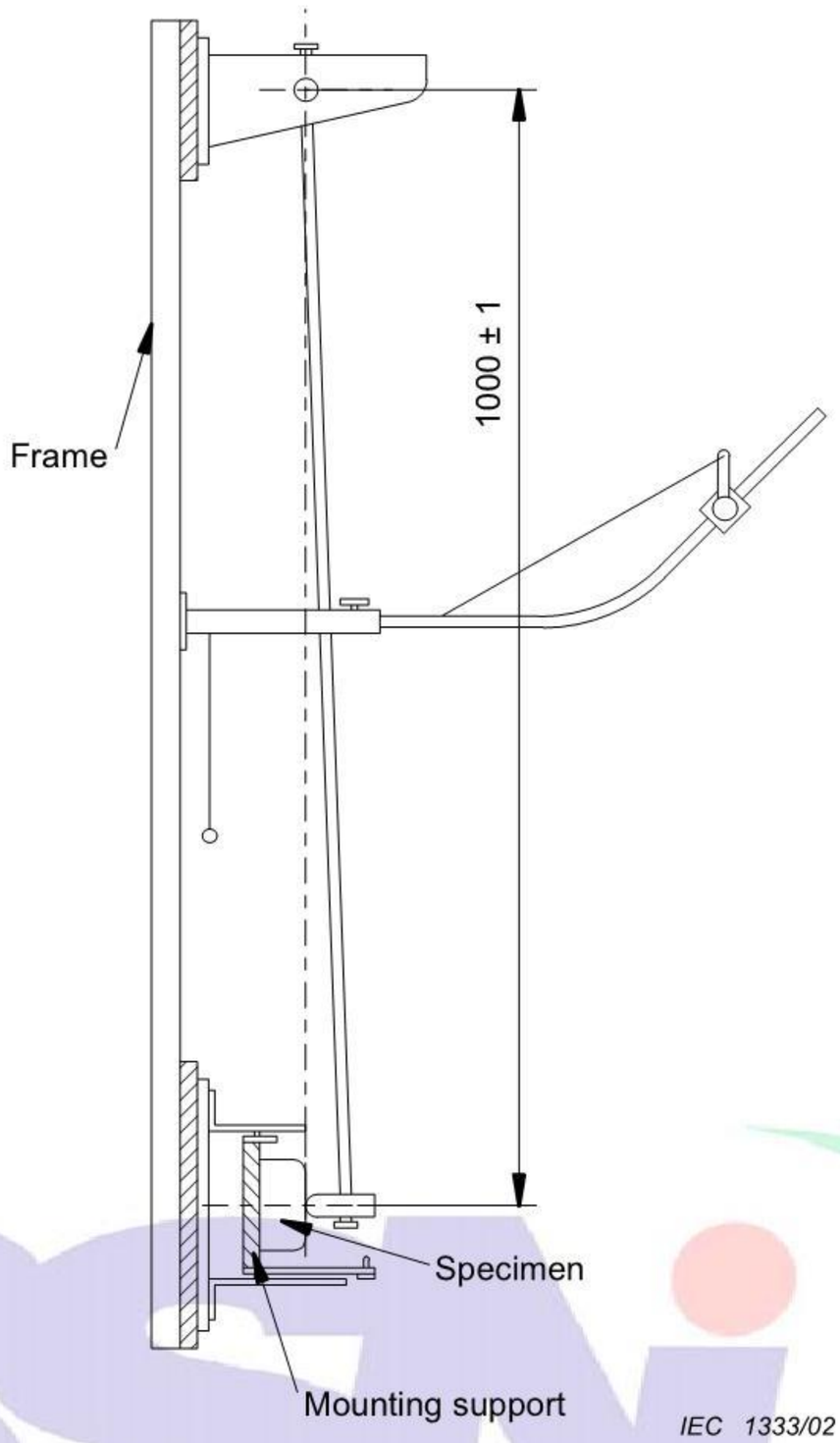
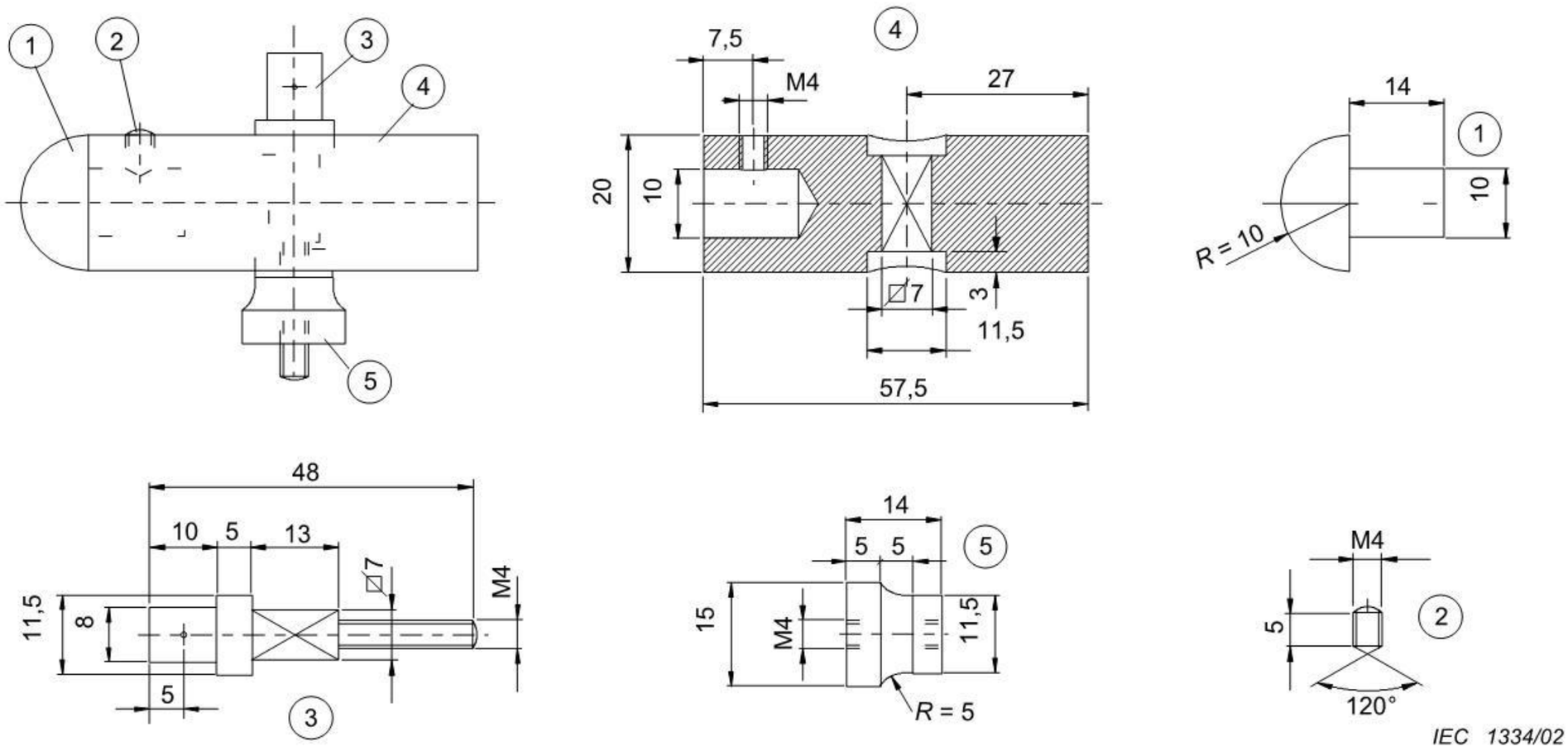


Figure 22 – Impact-test apparatus



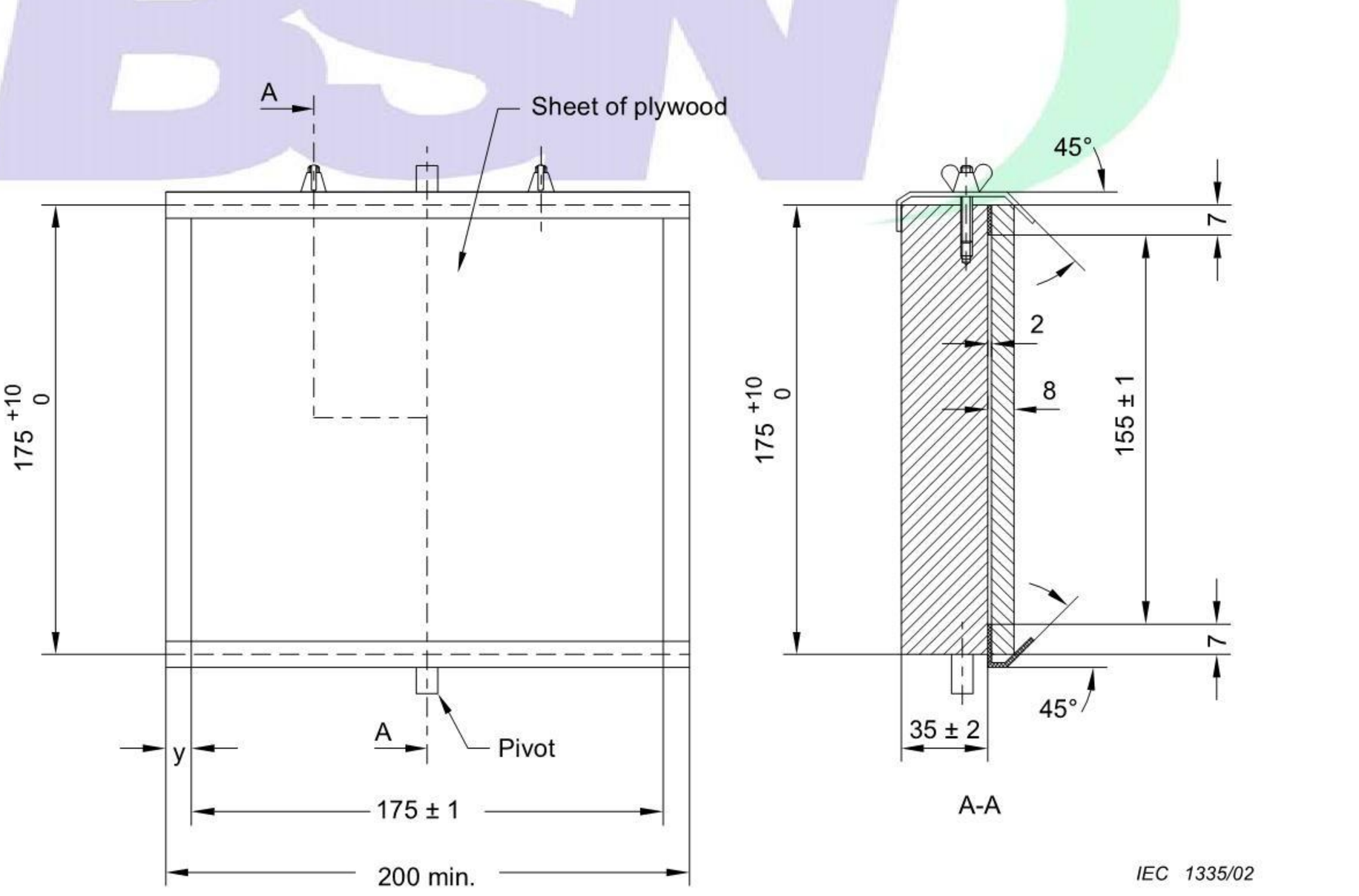
Key

① Polyamide

②, ③, ④, ⑤ Steel Fe 360

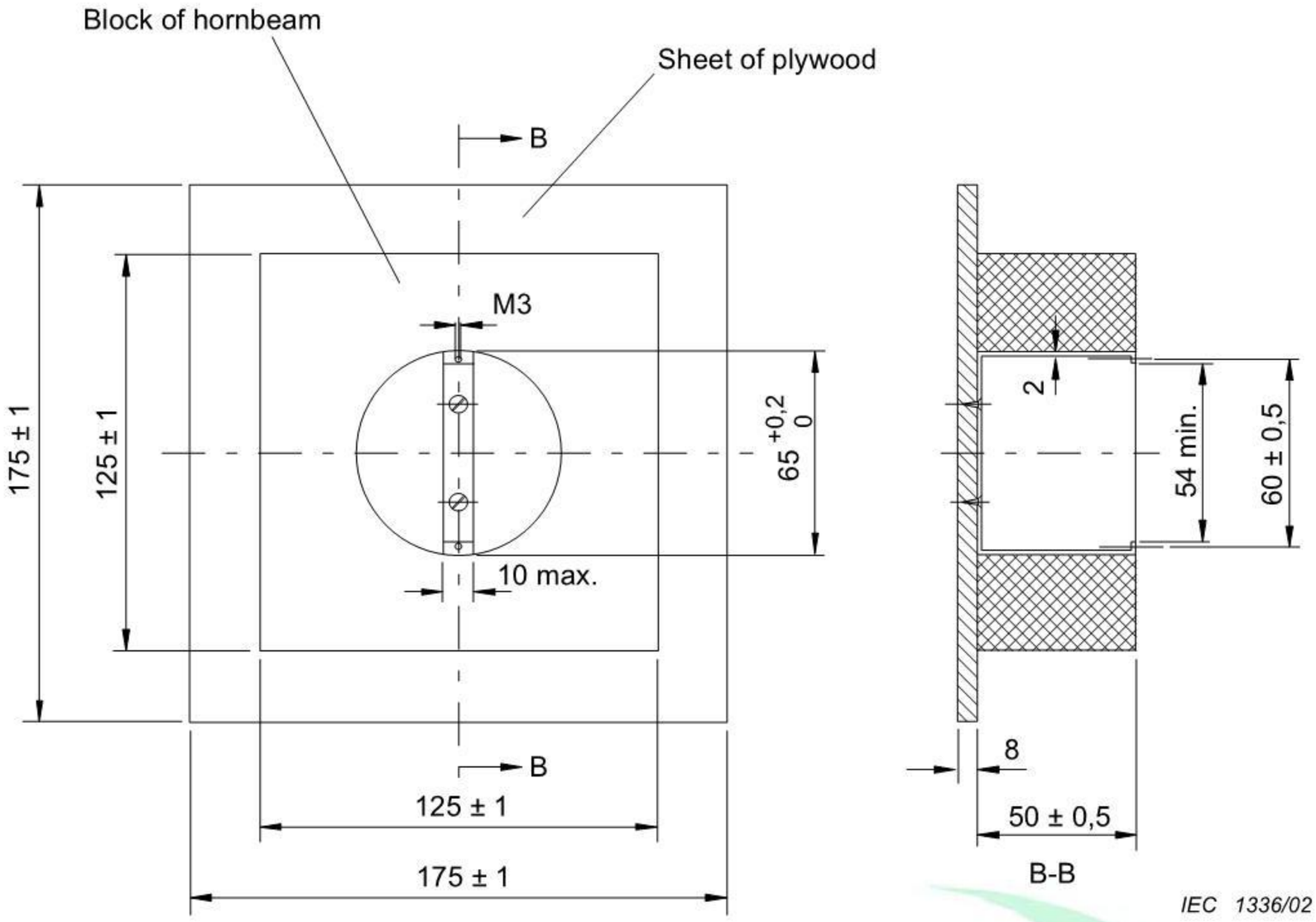
Dimensions in millimetres

Figure 23 – Details of the striking element



Dimensions in millimetres

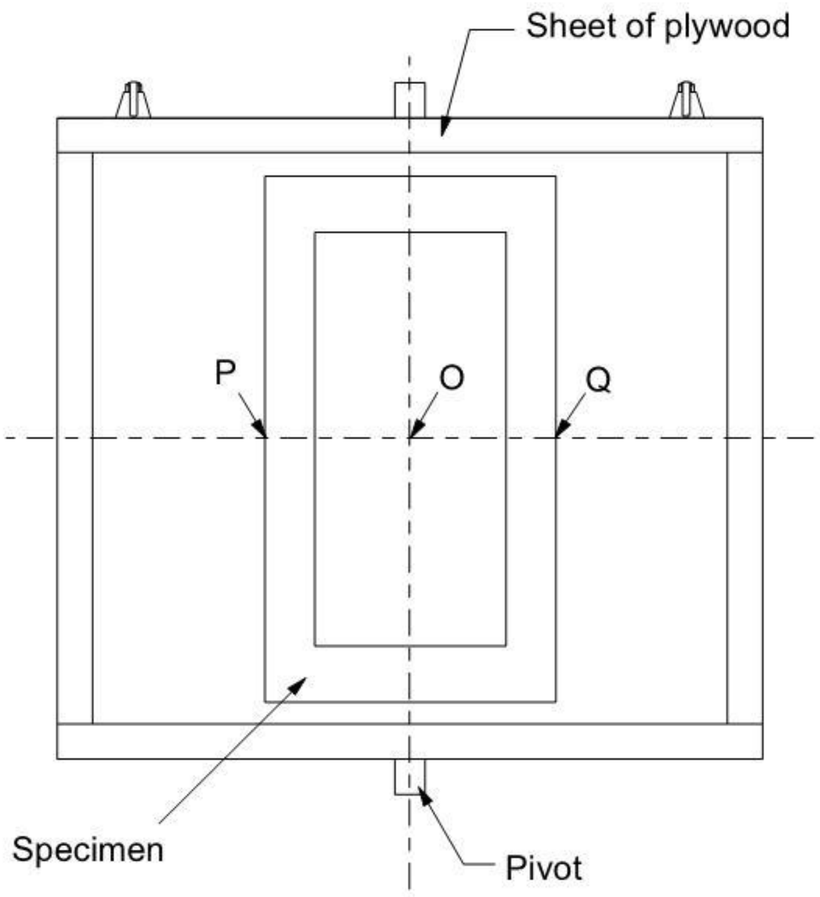
Figure 24 – Mounting support for specimens



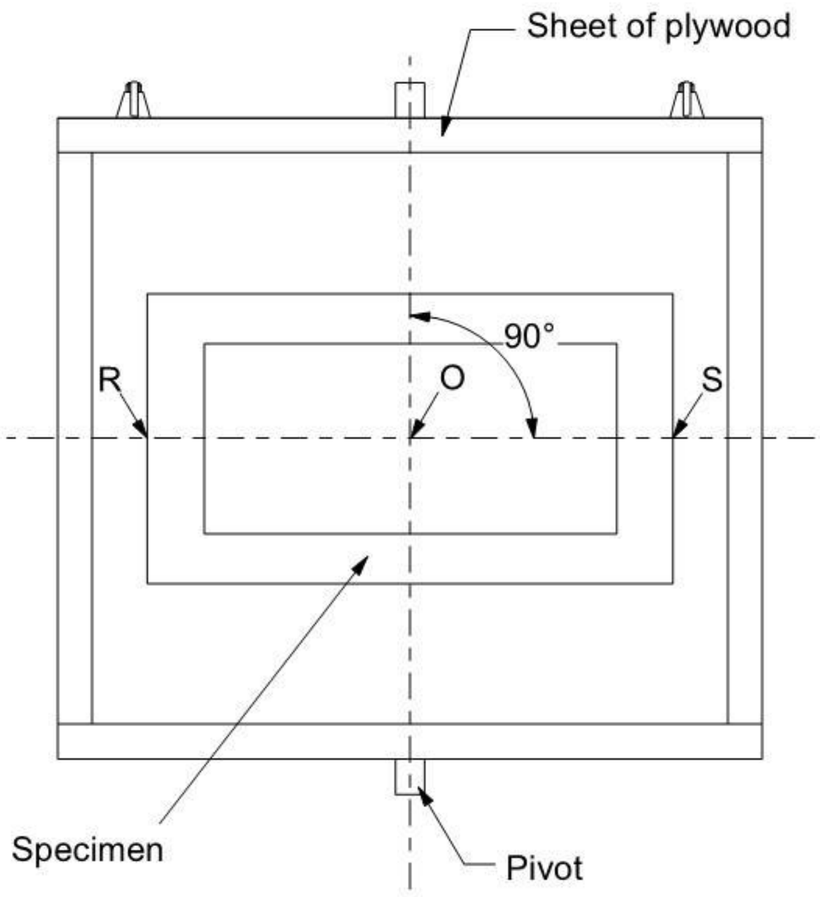
Dimensions in millimetres

The dimensions of the recess in the hornbeam block are given as an example. More general dimensions are under consideration.

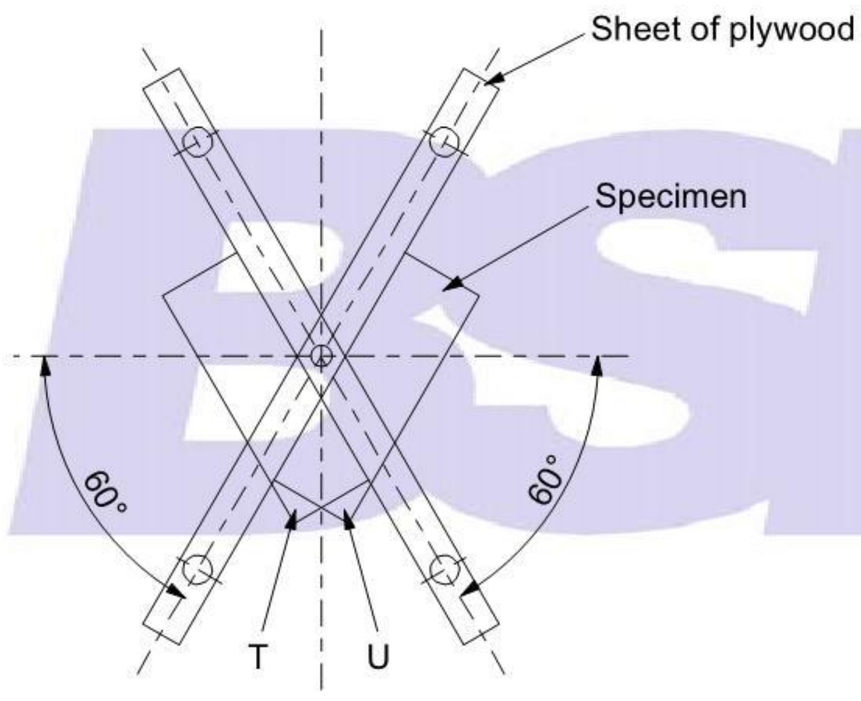
Figure 25 – Mounting block for flush-type accessories



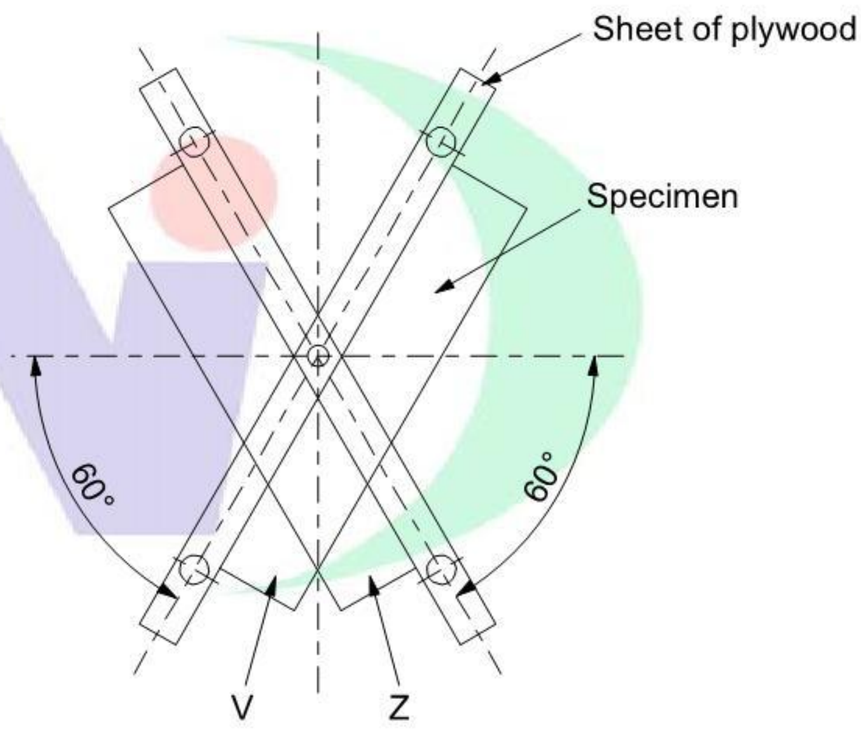
26a)



26b)



26c)



26d)

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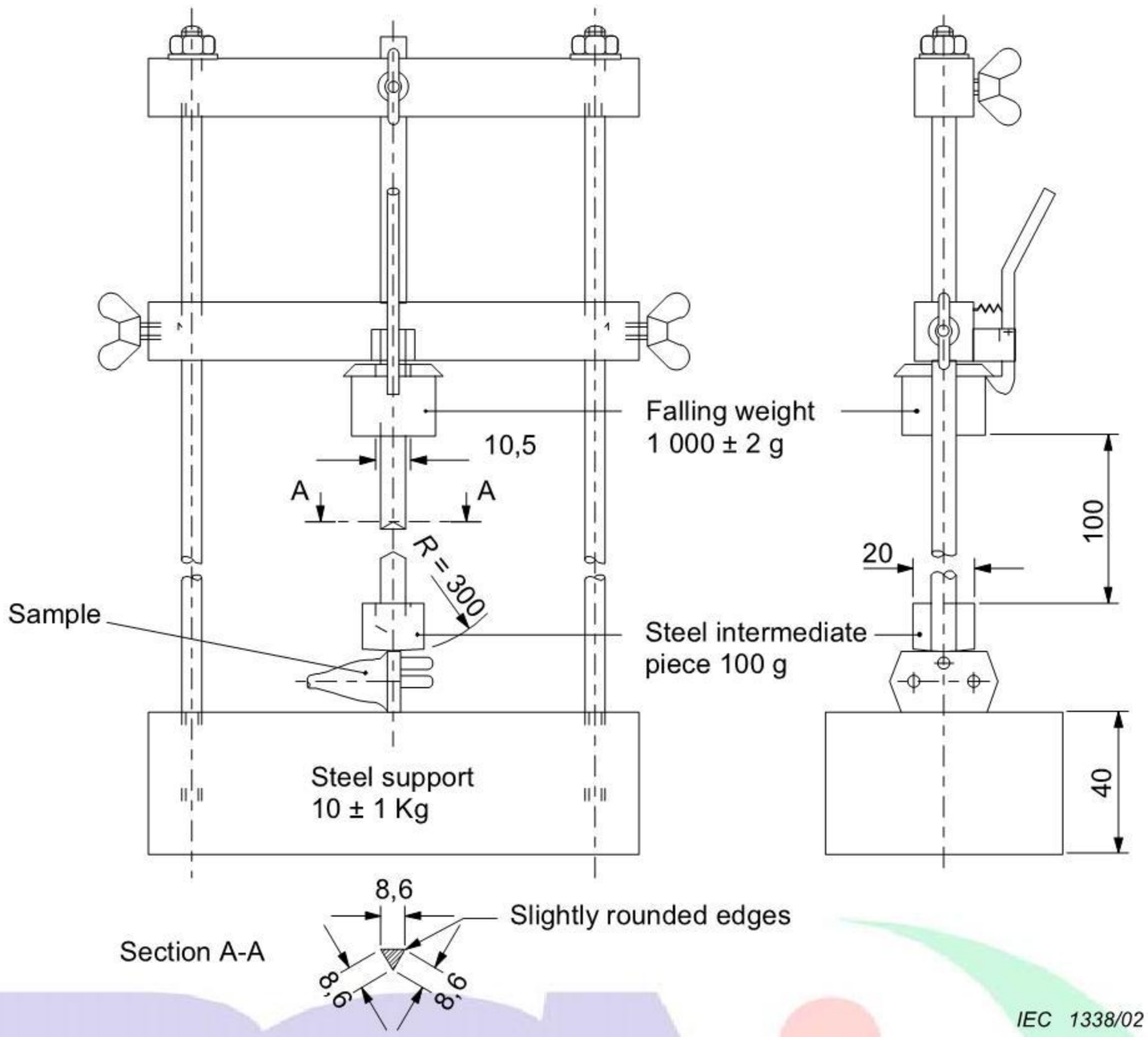
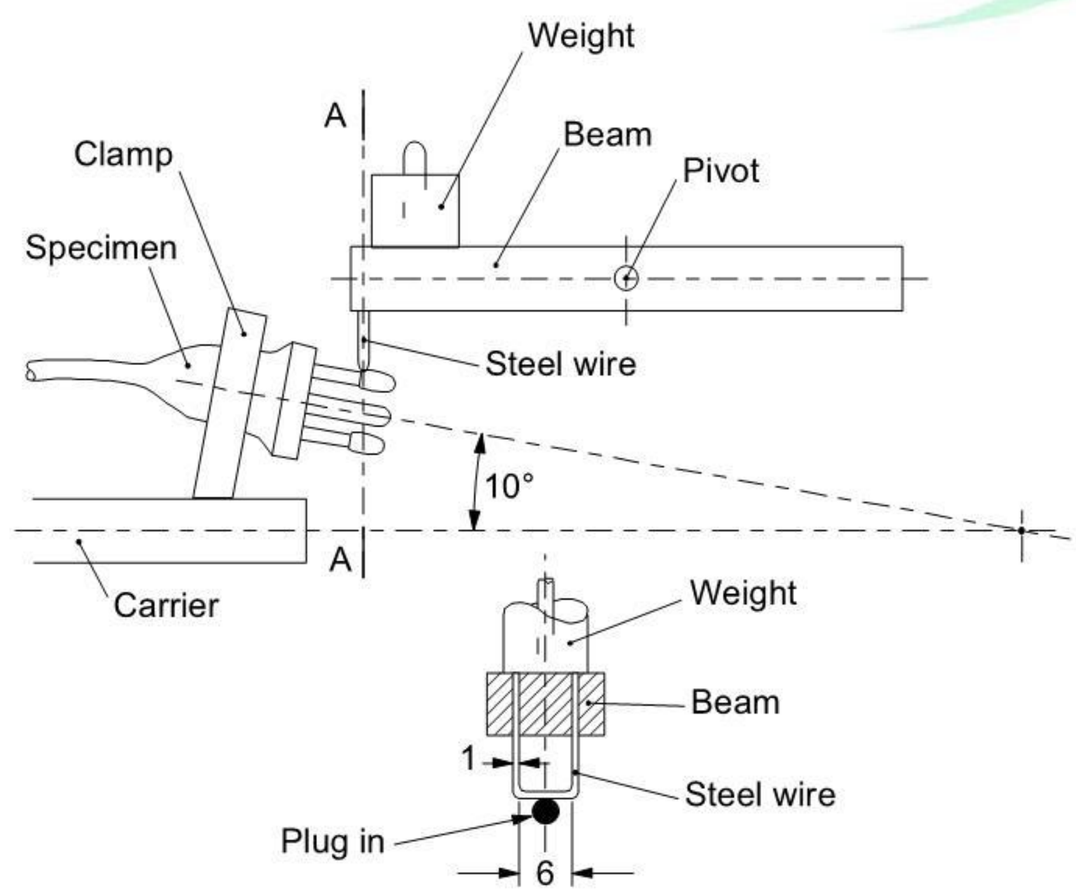
Application of the blows			
Sketch	**Total number of blows**	**Points of application**	**Parts to be tested**
26a)	3	One at the centre One between O and P [a] One between O and Q [a]	A
26b)	2	One between O and R [a] One between O and S [a]	A
26c)	2	One on the surface T [a] One on the surface U [a]	B, C and D
26d)	2	One on the surface V [a] One on the surface Z [a]	B, C and D
[a] The blow is applied to the most unfavourable point.			

Figure 26 – Sketches showing the application of the blows according to table 21



Dimensions in millimetres

Figure 27 – Apparatus for impact test at low temperature of 24.4



Enlarged part of section A-A showing steel wire

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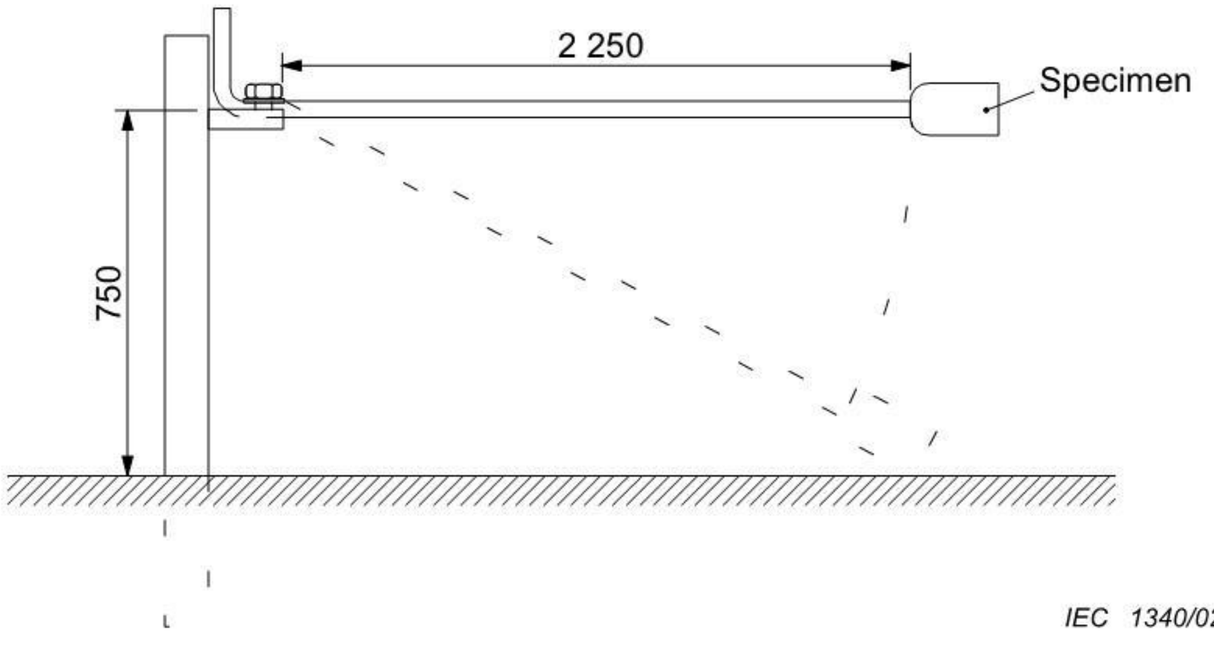
Dimensions in millimetres

Figure 28 – Apparatus for abrasion test on insulating sleeves of plug pins



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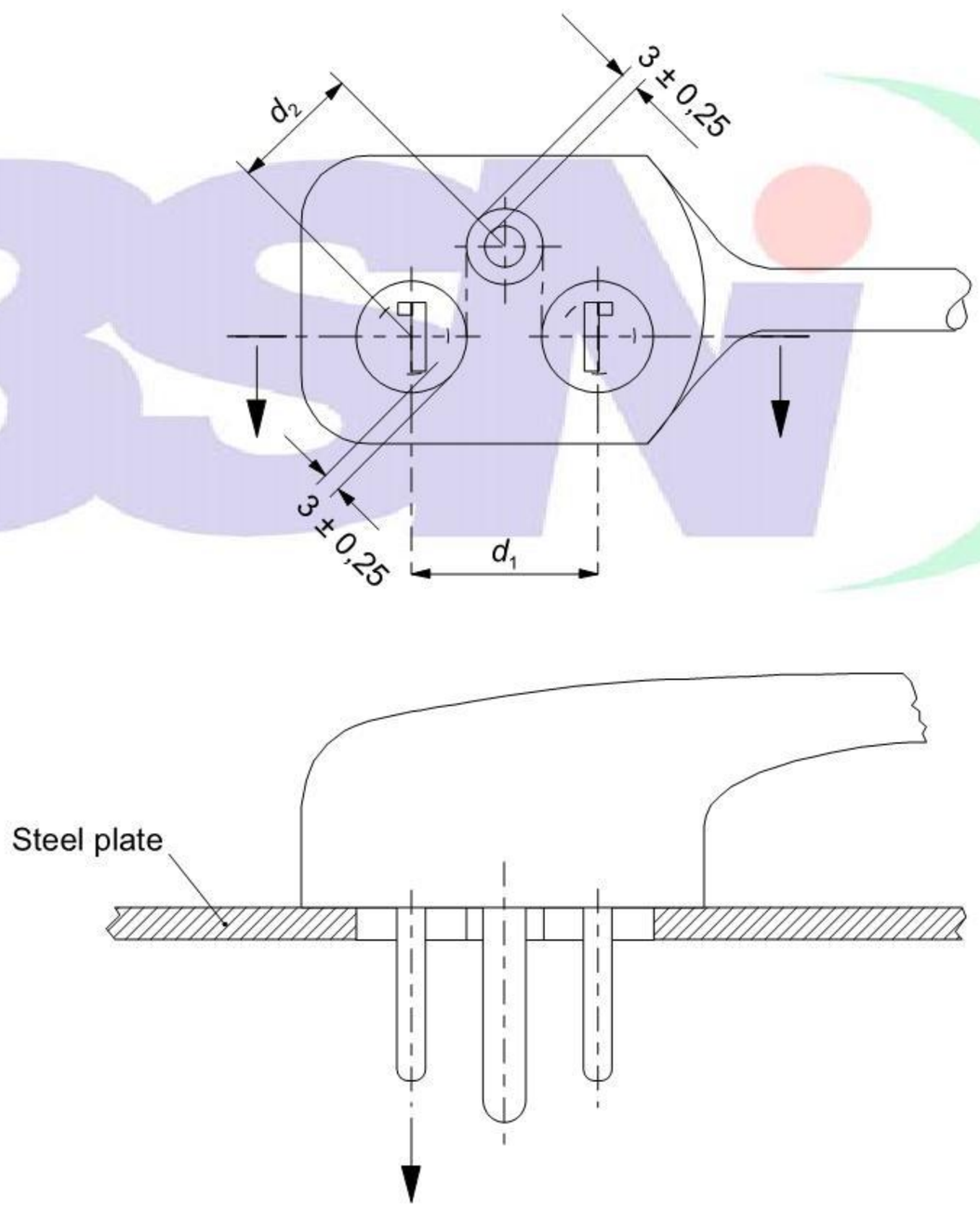
Dimensions in millimetres

Figure 29 – Arrangement for mechanical strength test on multiple portable socket-outlets



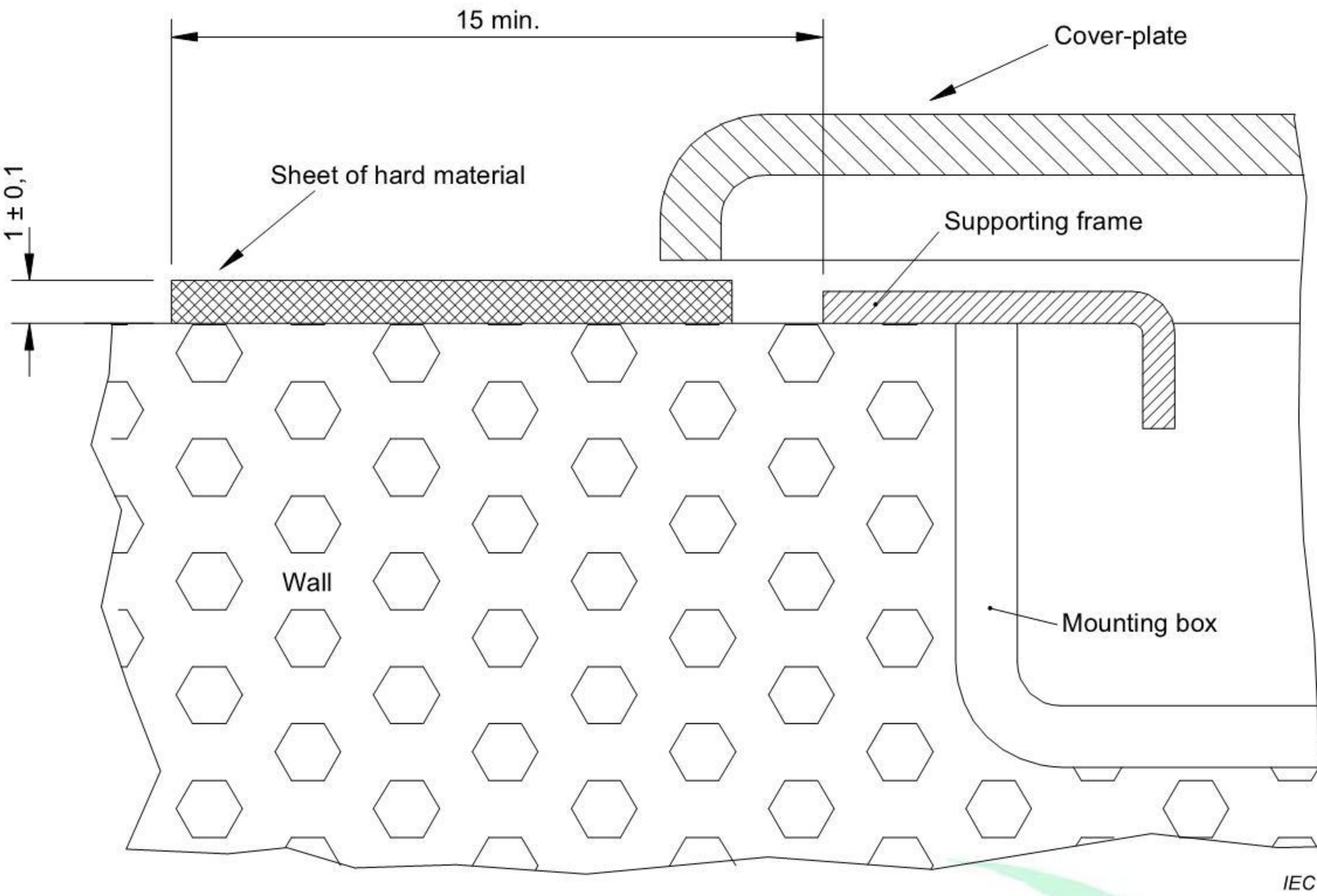
IEC 1341/02

Dimensions in millimetres

Key

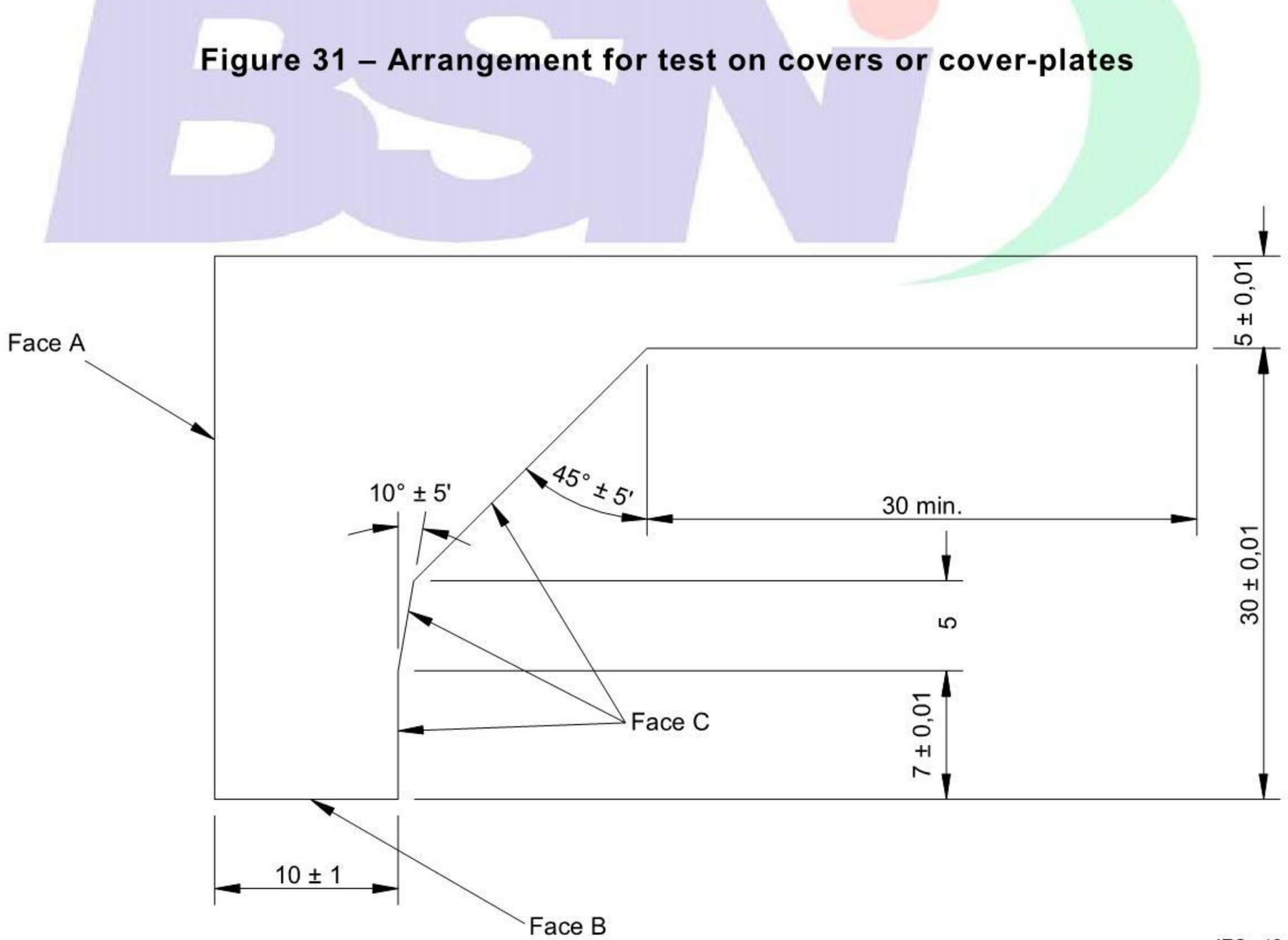
P Traction

Figure 30 – Example of test arrangement to verify the fixation of pins in the body of the plug



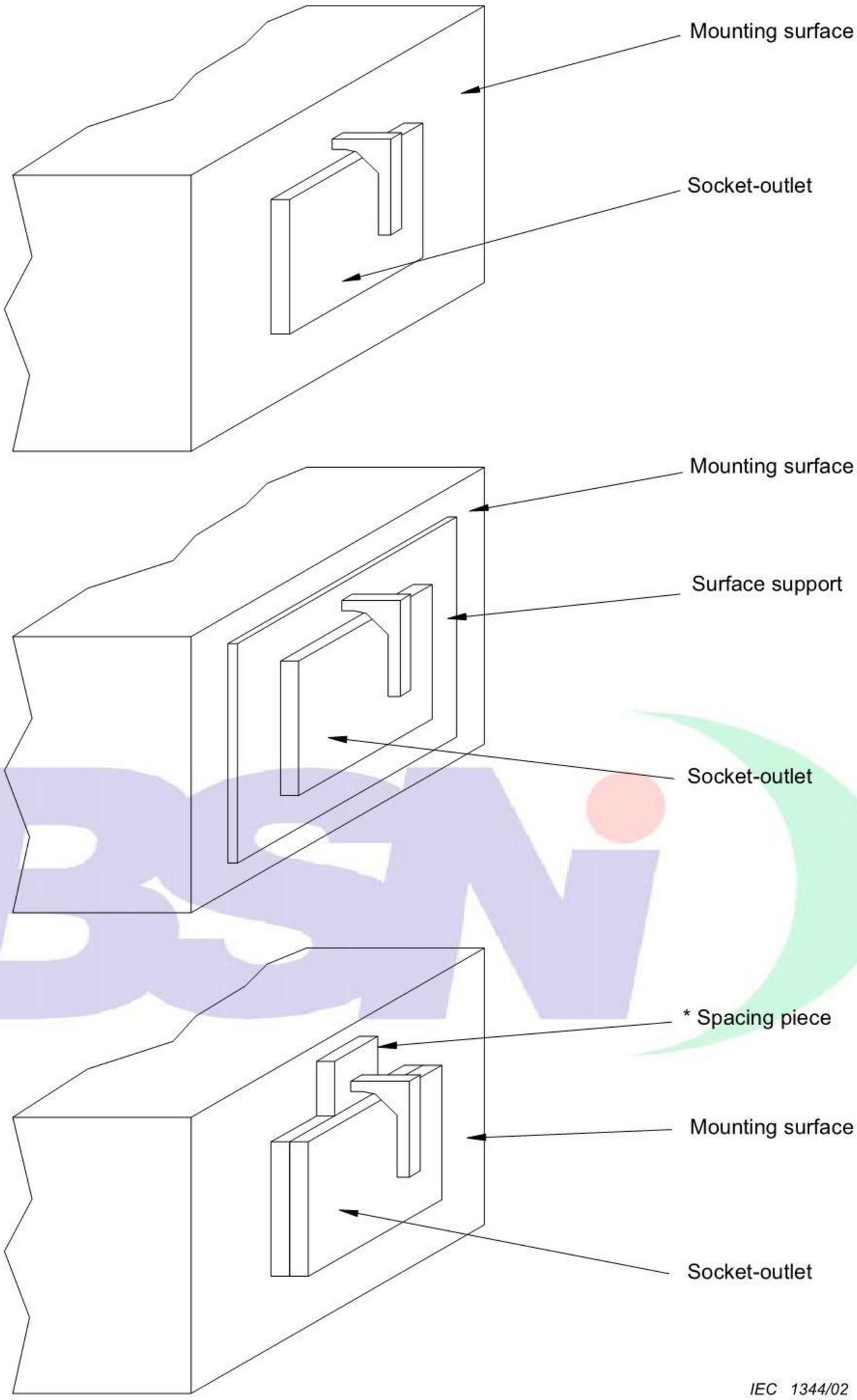
Dimensions in millimetres

Figure 31 – Arrangement for test on covers or cover-plates



Dimensions in millimetres

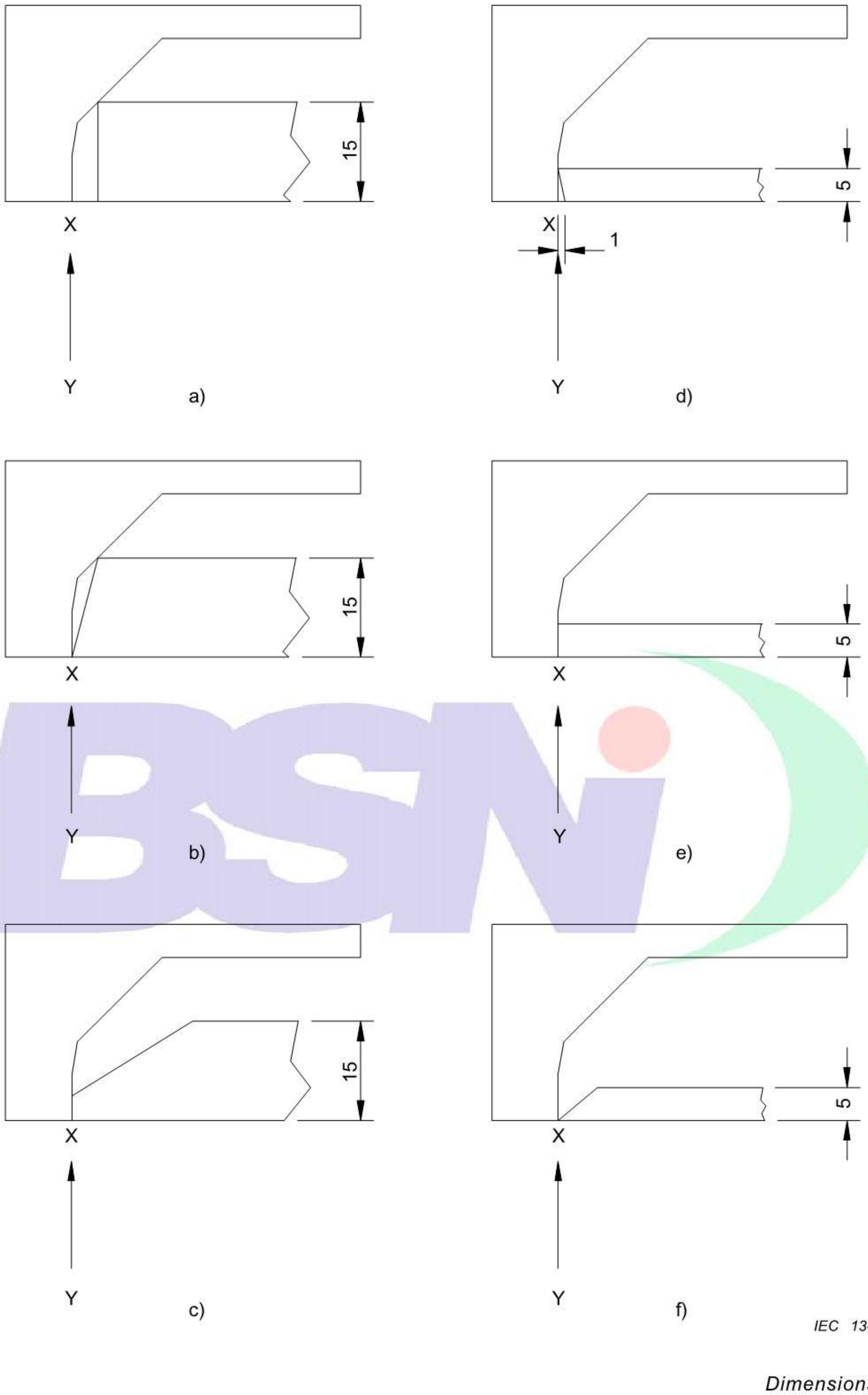
Figure 32 – Gauge (thickness about 2 mm) for the verification of the outline of covers or cover-plates



Dimensions in millimetres

* Spacing piece having the same thickness as that of the supporting part.

Figure 33 – Examples of application of the gauge of figure 32 on covers fixed without screws on a mounting surface or supporting surface



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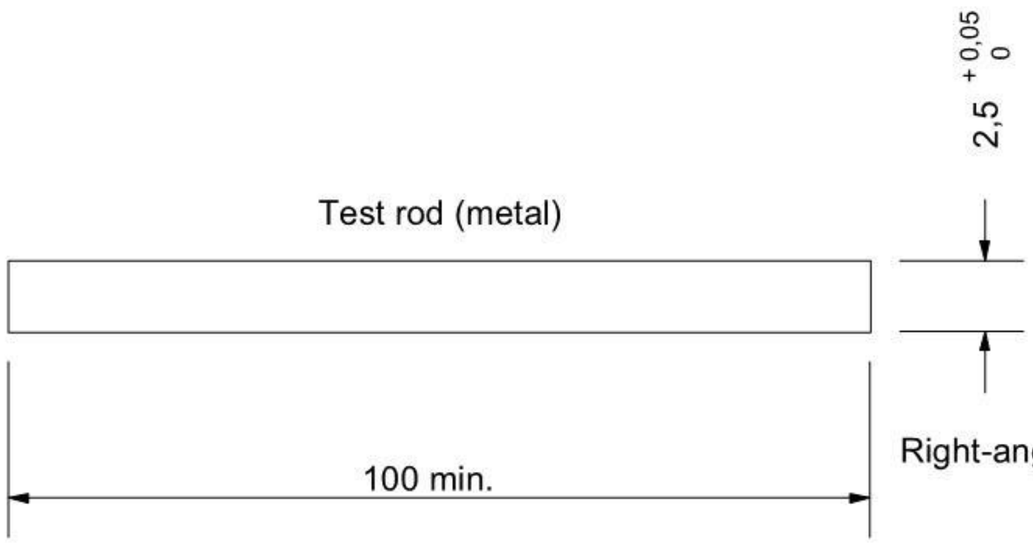
Dimensions in millimetres

Cases a) and b) do not comply.

Cases c), d), e) and f) comply (compliance shall, however, also be checked with the requirements of 24.18, using the gauge shown in figure 35).

Figure 34 – Examples of application of the gauge of figure 32 in accordance with the requirements of 24.17



Dimensions in millimetres

Figure 35 – Gauge for verification of grooves, holes and reverse tapers

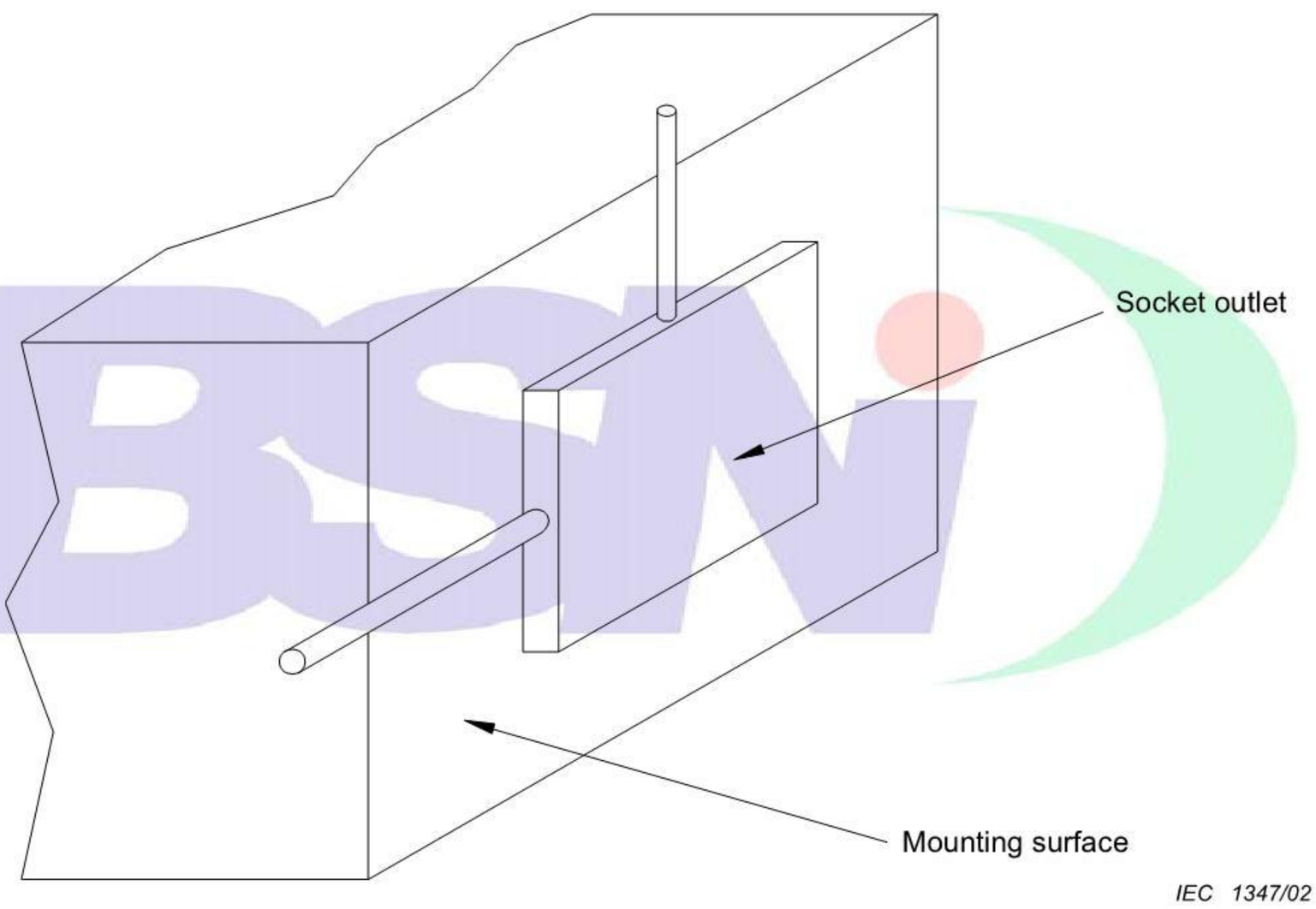
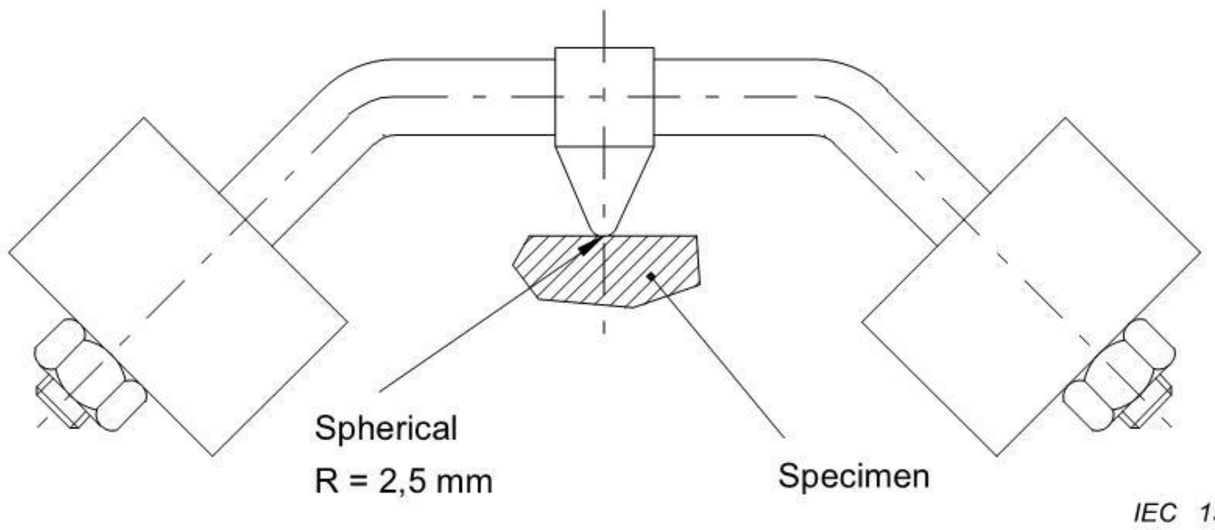


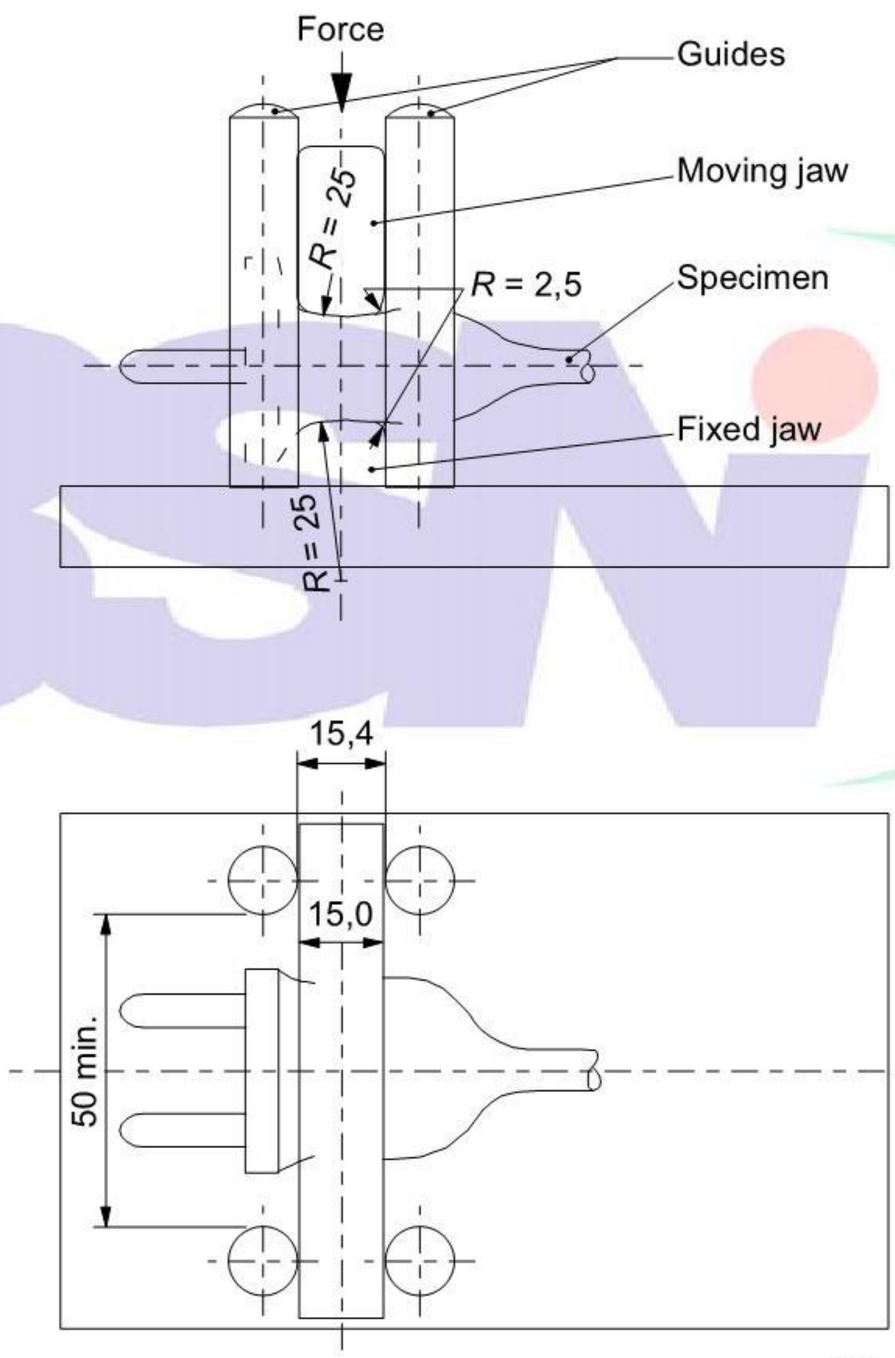
Figure 36 – Sketch showing the direction of application of the gauge of figure 35



IEC 1348/02

Dimensions in millimetres

Figure 37 – Ball pressure test apparatus



IEC 1349/02

Dimensions in millimetres

Figure 38 – Apparatus for compression test for the verification of resistance to heat of 25.4

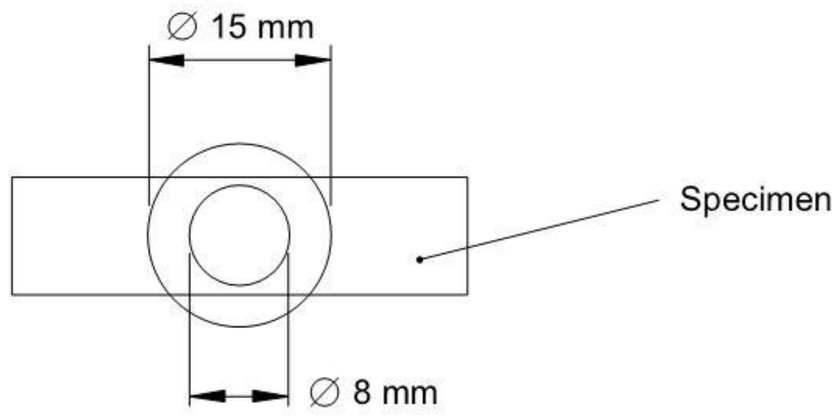
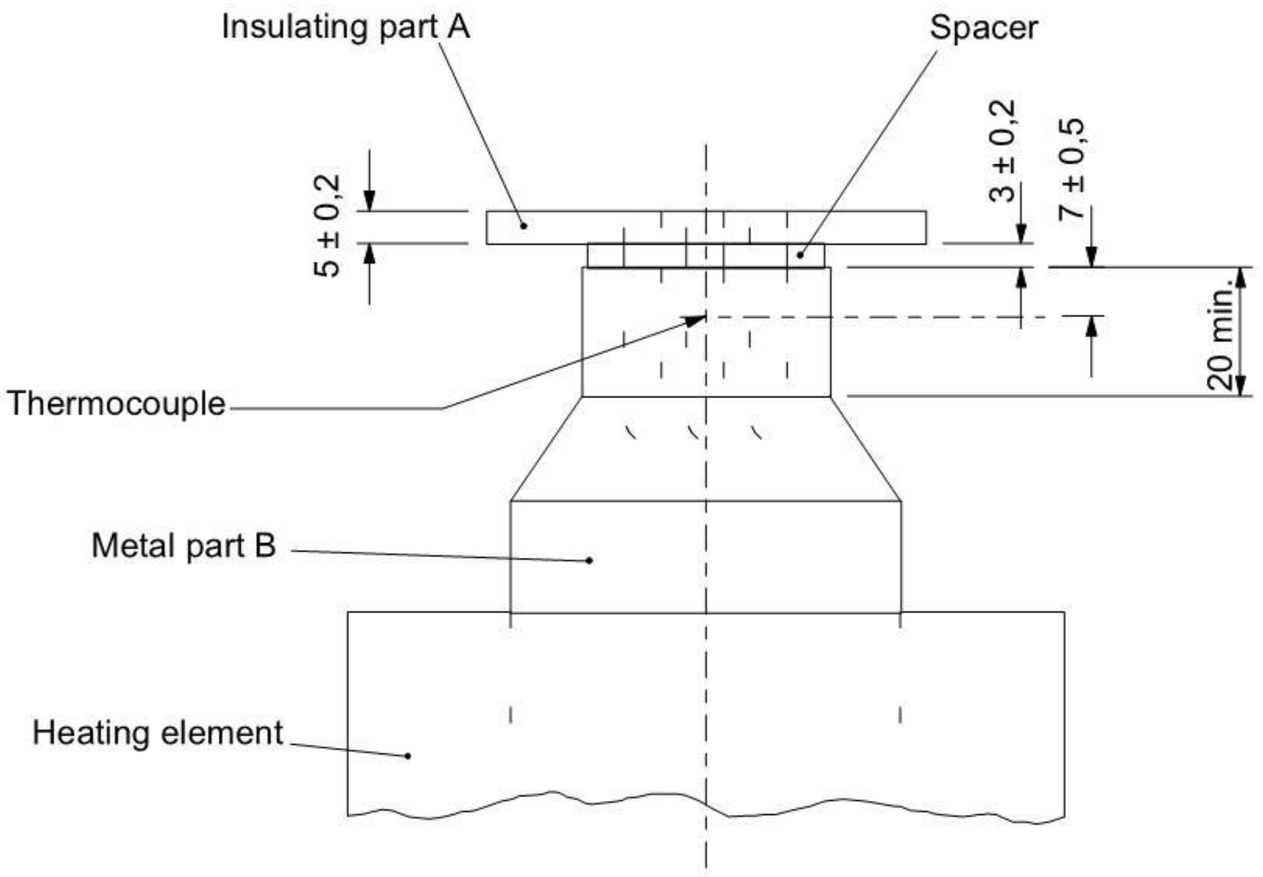
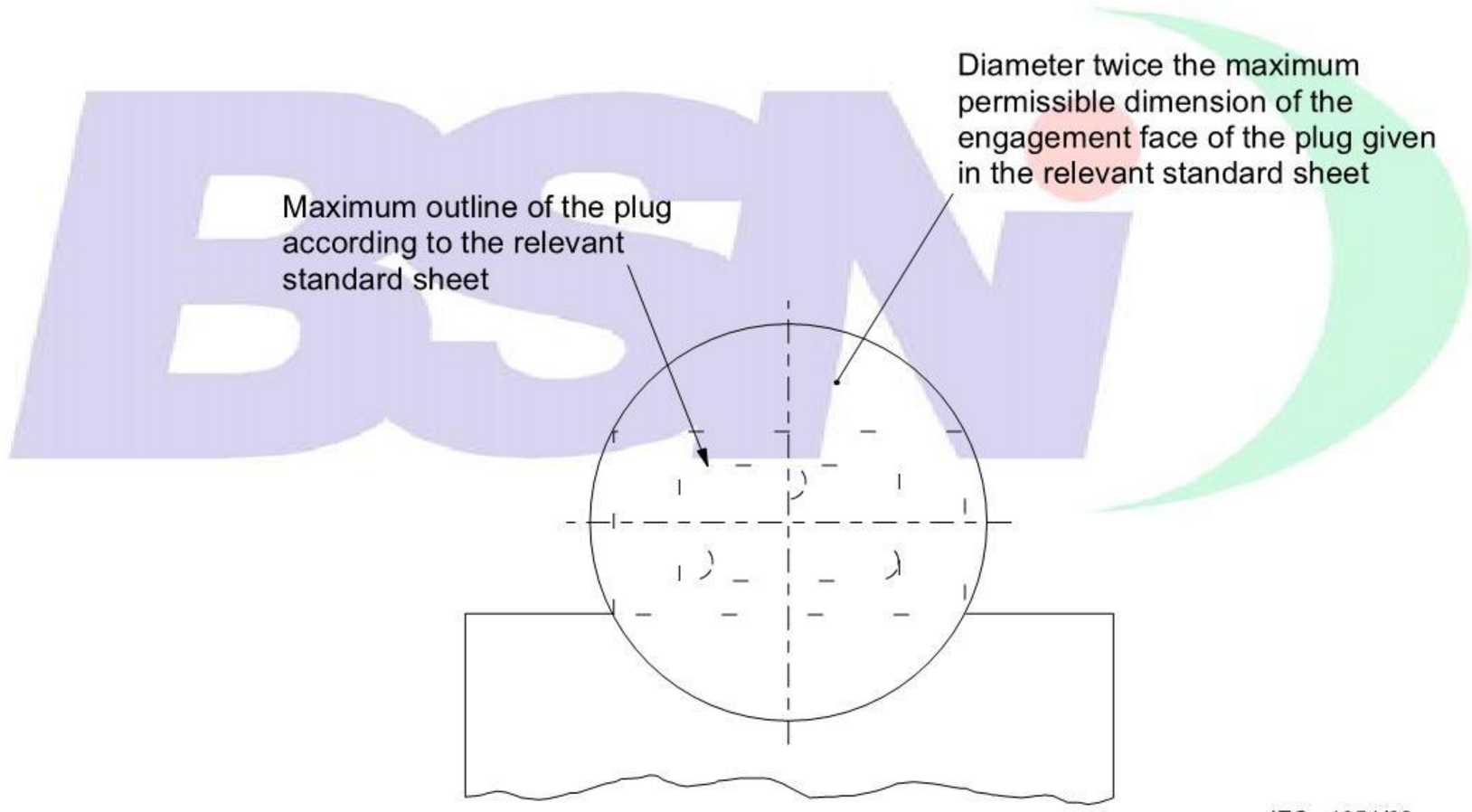


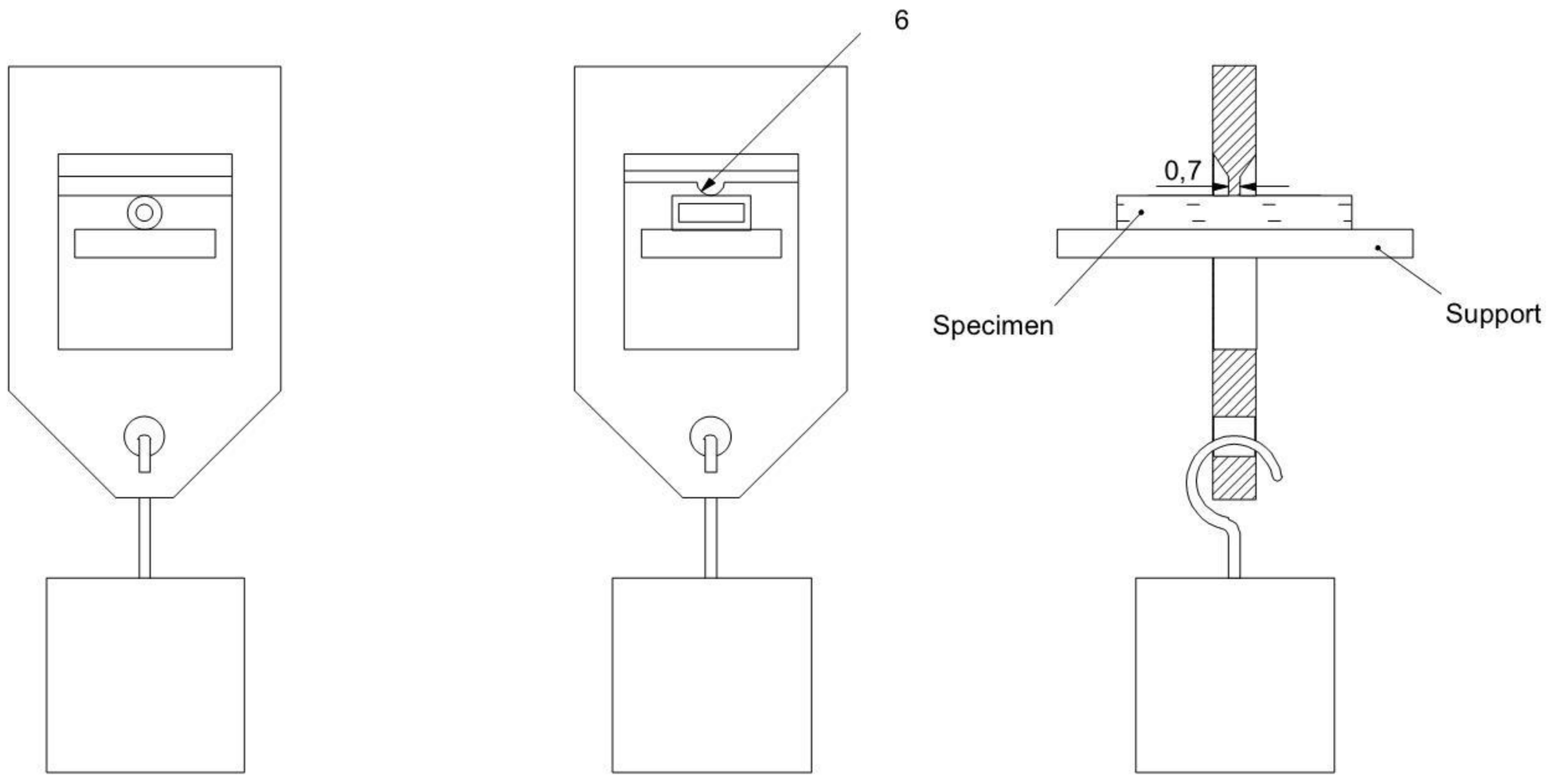
Figure 39 – Diagrammatic representation of 28.1.1





Dimensions in millimetres

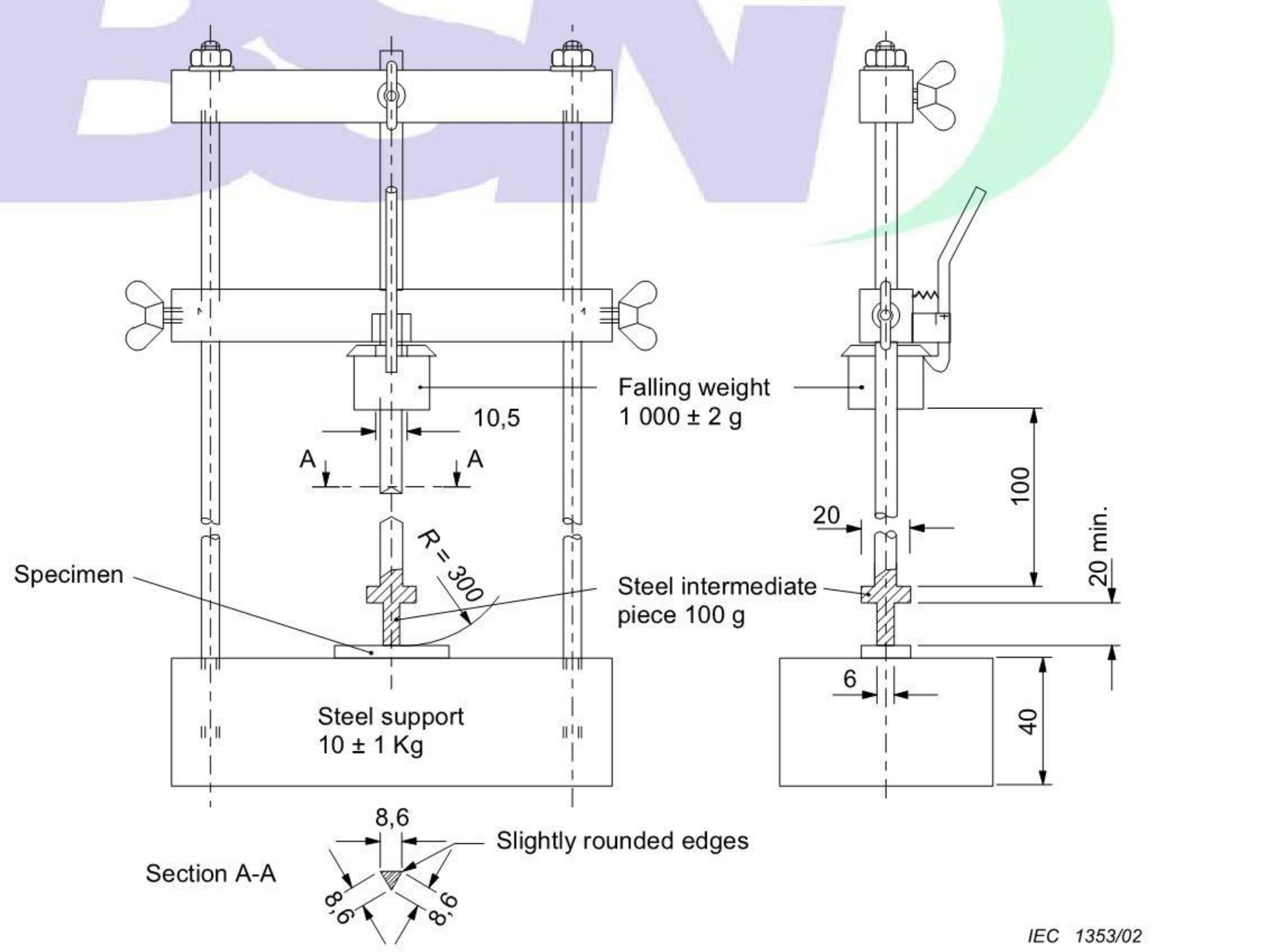
Figure 40 – Apparatus for testing resistance to abnormal heat of insulating sleeves of plug pins



IEC 1352/02

Dimensions in millimetres

Figure 41 – Apparatus for pressure test at high temperature



IEC 1353/02

Dimensions in millimetres

Figure 42 – Impact test apparatus on pins provided with insulating sleeves

Annex A
(normative)

Safety-related routine tests for factory-wired portable accessories (protection against electric shock and correct polarity)

A.1 General remarks

All factory-wired plugs and portable socket-outlets shall be subjected to the following tests, as appropriate. A diagrammatic representation is given in table A.1:

– two-pole polarized systems: clause A.2;
– more than two-pole: clauses A.2, A.3, A.4.

The test equipment or manufacturing systems shall be such that failed products are either made unfit for use or separated from satisfactory products in such a way that they cannot be released for sale.

NOTE "Unfit for use" means that the accessory is treated in such a way that it cannot fulfil the intended function. It is, however, accepted that repairable products (by a reliable system) may be repaired and re-tested.

It shall be possible by process or manufacturing system to identify that accessories released for sale have been subjected to all the appropriate tests.

The manufacturers shall maintain records of the tests carried out which show

– the type of product;
– the date of test;
– the place of manufacture (if manufactured in more than one place);
– the quantity tested;
– the number of failures and actions taken, i.e. destroyed/repaired.

The test equipment shall be checked before and after each period of use and for periods of continuous use, at least once every 24 h. During these checks the equipment shall show that it indicates faults when known faulty products are inserted or simulated faults are applied.

Products manufactured prior to a check shall only be released for sale if the check is found satisfactory.

Test equipment shall be verified (calibrated) at least once a year. Records shall be kept of all checks and any adjustments found necessary.

A.2 Polarized systems, phase (L) and neutral (N) – correct connection

For polarized systems the test shall be made using SELV applied for a period of not less than 2 s:

NOTE 1 The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

– *for plugs and portable socket-outlets, between the remote end of the L and N conductors of the flexible cable independently, and the corresponding L and N pin or contact of the accessory;*
– *for cord extension sets, between the L and N pin at one end of the flexible cable and the corresponding L and N contact at the other end of the flexible cable.*

Polarity shall be correct.

NOTE 2 Other suitable tests may be used.

For plugs and portable socket-outlets intended for use on three-phase supplies, the test shall check that the connection of the phase conductors is in the correct order of phase sequence.

A.3 Earth continuity

The test shall be made using SELV applied for a period of not less than 2 s:

NOTE 1 The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

- *for plugs and portable socket-outlets, between the remote end of the earth conductor of the flexible cable, and the earth pin or contact of the accessory, as appropriate;*
- *for cord extension sets, between the corresponding earth pin or earth contact of the accessory at each end of the flexible cable.*

Continuity shall be present.

NOTE 2 Other suitable tests may be used.

A.4 Short-circuit/wrong connection and reduction of creepage distance and clearances between phase (L) or neutral (N) to earth (⏚)

The test shall be made by applying at the supply end, e.g. to a plug, for a period of not less than 2 s:

- *1 250 V ± 10 % for accessories having a rated voltage of up to and including 130 V;*

NOTE 1 The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

or

- *2 000 V ± 10 % for accessories having a rated voltage exceeding 130 V;*

NOTE 1 The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

or

- *for all rated voltages, by applying an impulse voltage test using a 1,2/50 µs waveform of 4 kV peak value and three impulses for each pole, with intervals of not less than 1 s:*
  - ∞ *between L and* ⏚ ,
  - ∞ *between N and* ⏚ .

NOTE 2 L and N may be connected together for this test.

No flashover shall occur.

Table A.1 – Diagrammatic representation of routine tests to be applied to factory-wired portable accessories

Clauses	Number of poles	
	2	More than 2
A.2	X	X
A.3	–	X
A.4	–	X

Annex B
(normative)

Survey of specimens needed for tests

The number of specimens needed for the tests according to 5.4 are as follows:

Clauses and subclauses		Number of specimens		
		Fixed socket-outlets	Portable socket-outlets	Plugs
6	Ratings	A	A	A
7	Classification	A	A	A
8	Marking	A	A	A
9	Checking of dimensions	ABC	ABC	ABC
10	Protection against electric shock	ABC	ABC	ABC
11	Provision for earthing	ABC	ABC	ABC
12	Terminals	ABC[a]	ABC	ABC
13	Construction of fixed socket-outlets	ABC[b]	--	--
14	Construction of plugs and portable socket-outlets	--	ABC[b]	ABC[b]
15	Interlocked socket-outlets	ABC	ABC	--
16	Resistance to ageing, to harmful ingress of water and to humidity	ABC	ABC	ABC
17	Insulation resistance and electric strength	ABC	ABC	ABC
18	Operation of earthing contacts	ABC	ABC	ABC
19	Temperature rise	ABC	ABC	ABC
20	Breaking capacity	ABC	ABC	ABC
21	Normal operation	ABC	ABC	ABC
22	Force necessary to withdraw the plug	ABC	ABC	--
23	Flexible cables and their connection	--	ABC[c]	ABC[c]
24	Mechanical strength	ABC[d e]	ABC[d]	ABC[f]
25	Resistance to heat	ABC	ABC	ABC
26	Screws, current-carrying parts and connections	ABC	ABC	ABC
27	Creepage distances, clearances and distances through sealing compound	ABC	ABC	ABC
29	Resistance to rusting	ABC	ABC	ABC
28.1	Resistance to abnormal heat and to fire	DEF	DEF	DEF
28.2	Resistance to tracking[g]	DEF	DEF	DEF
30	Additional tests on pins provided with insulating sleeves	--	--	GHI[h]
	TOTAL	6	6	9

[a] One extra set of specimens is used for the test of 12.3.10, five extra screwless terminals are used for the test of 12.3.11 and one extra set of specimens is used for the test of 12.3.12.

[b] One extra set of membranes is needed for each of the tests of 13.22 and 13.23.

[c] One extra set of specimens is needed for 23.2 and 23.4 about non-rewirable accessories for each type of cable and cross-sectional area.

[d] One extra set of specimens is needed for 24.8 about shuttered socket-outlets.

[e] One extra set of specimens is needed for 24.14.1 and 24.14.2.

[f] One extra set of specimens is needed for 24.10 about plugs.

[g] One extra set of specimens may be used.

[h] One extra set of specimens is needed for 30.2 and 30.3 about plugs with pins with insulating sleeves.

Bibliography

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IEC 60364-4-41:2001, *Electrical installations of buildings – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60417-1:2000, *Graphical symbols for use on equipment – Part 1: Overview and application*

IEC 60670:1989, *General requirements for enclosures for accessories for household and similar fixed electrical installations*

IEC 61540:1999, *Electrical accessories – Portable residual current devices without integral overcurrent protection for household and similar use (PRCDs)*

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